

ITALY'S GREAT HORROR
OF
EARTHQUAKE AND TIDAL WAVE
TERRIBLE DEVASTATION AND
HEART-RENDING SCENES

IMMENSE LOSS OF LIFE AND HUNDRED MILLIONS
OF PROPERTY DESTROYED

THE MOST APPALLING DISASTER
OF MODERN TIMES

CONTAINING

VIVID DESCRIPTIONS OF THIS OVERWHELMING CALAMITY—
SUDDENNESS OF THE BLOW—GREAT NUMBER OF
VICTIMS—FALL OF GREAT BUILDINGS—THOU-
SANDS DRIVEN FROM THEIR HOMES

THIS UNPARALLELED CATASTROPHE
LEAVES MESSINA AND OTHER BEAUTIFUL
CITIES HEAPS OF RUINS

FROM STORIES TOLD BY EYE WITNESSES

TO WHICH IS ADDED

GRAPHIC ACCOUNTS OF THE ERUPTIONS OF ETNA, VESUVIUS
AND OTHER VOLCANOES, EXPLAINING THE CAUSES
OF EARTHQUAKES, TIDAL WAVES AND
VOLCANIC ERUPTIONS

COMPILED

BY JAY HENRY MOWBRAY, Ph.D., LL.D.

The Celebrated Author Traveller and Lecturer

Embellished with a Great Number of Superb Photographic Views
showing heart-rending Scenes in this Appalling Calamity

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PREFACE.

DISASTER without parallel on the blood-stained pages of history; almost a quarter of a million of human beings swept into eternity in scarce more than the twinkling of an eye; thousands maimed and bruised and battered, bereft of home and family and driven to the verge of madness by their sufferings; millions of dollars worth of property destroyed; half a dozen cities swept away in one supreme cataclysm and scores of lesser towns and villages wiped from the face of the earth.

That is the stupendous story of the great earthquakes and tidal waves that devastated Southern Italy and Sicily in the closing days of 1908.

It is the terrible climax of a series of convulsions of nature that began six years before, when Mont Pelee with one foul breath, blotted out 40,000 lives on Martinique.

Then came San Francisco, with a property loss and suffering heretofore unequalled.

Valparaiso and Santiago, Chile, next were swept by the avenging hand of nature.

Kingston, Jamaica, was scourged till it almost ceased to exist.

Flame or tidal wave in each contributed to swell the terrible total of destruction.

But Italy's devastation was far greater than any of these, Tidal waves followed close upon the most terrific earth shocks man ever had been called upon to suffer. Flame added to the horror and pestilence stalked over the shattered ruins and took its added grim toll of death from the serried ranks of the mind-wrecked and nerve-shattered survivors of the earlier horrors.

The shaken area was almost as large as the State of Pennsylvania. Throughout this, the most historic and one of the most fertile regions of earth, one in every two of men, women and

children perished within the space of less time than it has taken to pen these lines.

Small wonder that a horror-stricken world stood aghast at Italy's agony. The human intellect could scarcely grasp the immensity and thoroughness of the horror.

After the first shock came a paralyzed lull. Then the world fairly leaped to the aid of the stricken nation.

In every civilized city on the globe money was poured out like water for the succor of the survivors. Civilization's debt to Italy was repaid a thousandfold.

The dead were past even exhumation. Buried deep beneath the debris of the homes they loved so well, their bones will crumble to the dust of the centuries. Nature was the only gravedigger countless thousands will ever know.

Messina, Reggio and their neighboring towns may rise, phoenix-like, from their ashes, but it is doubtful. Certainly centuries must elapse. City and population alike have paid their tribute to nature with their lives. It seems to-day to be a death that can know no resurrection.

Men are only now delving in the ruins of Pompeii and Herculaneum, which perished twenty centuries ago. The disaster that overwhelmed them was scarce more complete than Italy's latest devastation. The toll of human life exacted was infinitely smaller, yet they could not survive.

These modern victims of the earthquake's wrath outlived damage in the past at the hands of the all-powerful forces that are beyond and above man's guidance. Now they have suffered destruction so utter and so complete that any attempt to reconstruct them must be reconstruction indeed and repopulation as well.

The vines will still grow on Etna's sun-kissed slopes; wine and olives still will pour from the Calabrian steeps. That is true. And men will be found who will dare the dangers of this oft-scourged land in the future as their forefathers have done in the countless centuries of a horror-stained past.

But there are too few left to make more than half a dozen

villages. The remnants of the vast army of workers who thronged this human bee hive will have no companion in the shattered streets save the wraiths of those who paid the penalty of their temerity and their patriotism with their lives.

The world speaks of this stupendous disaster as Italy's. Yet it is America's in scarcely less a measure. Hardly a family in all the stricken region but had at least one breadwinner on our own side of the Atlantic.

Scarcely a home in all America which housed a family of Italian parentage but mourns for loved ones lost.

There is a lesson in all things. But that lesson can convey no rebuke to the hardy peasants who loved the land that their forefathers loved. They took the well-known risk and paid the penalty with their lives. So be it.

But if we of to-day, in a land blessed by nature and blossoming like the rose, fail to read aright the ages-old story; if we do not realize, as never before, that there is over and above us a power greater than our own, a power who holds the lightnings in His grasp and the hurricane in the hollow of His hand, the martyrs who perished on the Sicilian and Calabrian shores have died in vain.

GREAT EARTHQUAKE DISASTERS OF HISTORY.

B. C. 464—Laconia shaken and Sparta ruined; more than 20,000 persons killed.

A. D. 19—Syria devastated; 120,000 persons killed.

157—Pontius and Macedonia, Asia; a great number of cities laid in ruins and uncounted lives lost.

742—Syria, Palestine and Western Asia; many towns destroyed and loss of life recorded as "incalculable."

936—Constantinople destroyed and Greece shaken, with enormous loss of life.

1137—Cantania, Sicily, destroyed; 1500 killed.

1169—Cantania shaken; its cathedral destroyed; thousands killed.

1268—Cilicia, Asia Minor; 60,000 killed.

1456—Naples and vicinity; 40,000 killed.

1531—February 26, Lisbon; 30,000 killed.

1626—July 30, Naples; 70,000 killed.

1667—Schamaki; 80,000 killed.

1692—June 7, Port Royal, Jamaica, 3000 killed and the city laid in ruins.

1693—September, Sicily, 100,000 killed.

1703—February 2, Tokio, Japan; 200,000 killed.

1706—November 3, Abruzzi, Italy; 5000 killed.

1716—Algeria, 20,000 killed.

1726—September 1, Palermo, Italy; 6000 killed.

1731—November 30, Pekin, China; 100,000 killed.

1746—October 28, Lima, and Callao; Lima reduced to ruins with only 21 of 3000 houses left standing; comparatively small loss of life, 1141 of a population of 50,000 having been killed.

1751—May 24, Concepcion, Chile, destroyed; 10,000 killed.

1754—Cairo, Egypt; 40,000 killed.

1755—November 1, "The Great Lisbon Earthquake," cost 20,000 lives and engulfed city; subject of a notable description by Grace Aguilar, in her novel, "The Escape."

1759—October 30, Syria; 20,000 killed.

1773—June 7, Santiago, Guatemala, engulfed.

1783—February 5, Messina; 60,000 killed.

1797—Santa Fe and throughout Central America; 40,000 killed.

1812—March 26, Caracas, Venezuela; 12,000 killed.

1819—June 16, Cutch, India; 20,000 killed; contour of vast territory changed.

1822—August 10, Aleppo; 20,000 killed.

1822—November 19, West Coast of Chile; 10,000 killed.

1835—February 20, Concepcion, Chile; partly destroyed; 5000 killed.

1851—August 14, Milfi, Italy; 14,000 killed.

1852—September 16, Manila. Philippine Islands; partly destroyed with great loss of life.

1855—Tokio partly destroyed; 10,000 killed.

1857—December 16, Calabria, Italy; 10,000 killed.

1859—March 22, Quito Ecuador; 5000 killed.

1860—March 20, Mendoza, S. A., 7000 killed.

1863—July 2, Manila, Philippines; 1000 killed.

1863—August 15, Peru and Ecuador; series known as the "Great South American Earthquakes," which followed hurricanes, earth tremors, and volcanic eruptions, ending in tremendous shocks of August 13 to 16 and occasioning vast tidal waves, causing 25,000 deaths and enormous damage to property.

1875—May 15, Columbia, South America; 14,000 killed.

1881—April 3, Scio, Italy; 4,000 killed.

1883—August 26, Krakatoa, volcanic island in Sunda Straits; 50,000 killed.

1883—October 16, Anatolia Asia, and many surrounding towns destroyed.

1885—July 8, Cashmere; 20,000 killed.

1886—August 31, Charleston, S. C., and the South Atlantic Coast; 98 killed; property loss, \$8,000,000.

1887—February 24, Switzerland, France and Northern Italy; 2000 killed.

1888—March, Yun Nan, China; 4000 killed.

1888—Japan, Province of Tushima, 165 miles north from Tokio; 600 killed.

1891—October 28, severe shocks in Mino and Owari Provinces, Japan; 7000 killed; 200,000 houses destroyed.

1897—June 12, Assam, India; 1,750,000 square miles shaken; believed the greatest that ever happened.

1902—May 8, Martinique, eruption of Mount Pelee follows quake; Saint Pierre destroyed; 40,000 killed.

1905—Southern Italy; 600 killed.

1906—April 18, San Francisco; city damaged by quake and in large part destroyed by fire.

1906—August 16, Valparaiso, Chile; 1000 killed; 100,000 rendered homeless.

1907—January 14, Kingston; 1200 killed.

1908—Earthquake and tidal wave in Italy.

INTRODUCTION.

EARTHQUAKE disasters have followed each other with appalling frequency throughout the centuries, and have, as in the dreadful Italian catastrophe, proved a scourge of plague proportions; yet scientists are at loggerheads over the cause of this phenomenon, and it is only within the last thirty years that the study of earthquakes has been taken up for serious investigation.

Several distinct causes are suggested for the deadly phenomena. Great concussions, even on the surface, as in the great landslide at Rossberg, Switzerland, are capable of producing powerful shocks in all directions; and where these slides are beneath the surface they are able to bring about a disaster like that of San Francisco. Again, it is believed, that sudden movements of the molten interior of the earth, against the crust may be responsible for the violent tremors.

A RECENT THEORY.

The latest theory, which is regarded as a plausible one, is the result of years of investigation by the veteran English seismologist, Professor Milne. He believes the records now at our command, showing the districts most frequented by earthquakes and the time at which they occur, correspond to the changes in the direction of the earth's pole, which is constantly shifting its position.

The reasons for the shift of the pole is put down to the movement of rock material within the liquid portions of the earth just below the crust. These same migrations of huge quantities of solid matter shift the axis of the earth; but they do more—they appear in certain places and exert enormous pressure upon those places, and create earthquakes, often with the attendant discharge

of molten matter through volcanoes adjacent to the place of the quake.

The causes for the earth-tremors—the presence of which can be noted thousands of miles from the centre of disturbance—are, therefore, still a matter of conjecture. But no such conflict of opinion exists as to the localities most afflicted. In fact, scientists have agreed that there are two great zones of earthquakes. The most important of these zones includes some 54 per cent. of all the shocks, and is outlined by the Alps and the Mediterranean (where the Italian disaster occurred), the Caucasus and the Himalayas.

The other belt surrounds the Pacific Ocean, following the line of the big mountain ranges in the western part of North and South America, and festooning the islands on the borders of Eastern Asia and Malaysia. This latter belt includes 41 per cent. of all the shocks studied, so that 95 per cent. of all recorded shocks belong to one or the other of the two great belts.

STUDIED BY JAPAN.

So ably have seismologists handled the subject of earthquakes that they have been able to deduce most interesting facts regarding their occurrence. For instance, Dr. Omori, the distinguished professor of seismology in the University of Tokyo (Japan, because it is a victim of shocks, is proving an excellent student of them), has brought out the fact that the earthquakes follow each other in these two belts in a systematic way. They do not appear as an extension of each other in the same belt; but invariably when there has been a violent tremor in one province, the next disturbance is likely to occur in a distant section in the same belt rather than a neighboring one.

It was because of this that Professor Omori, on his visit to California, after the earthquake of April 18, 1906, was able to express the view that the next great shock upon the Pacific coast of North and South America would occur in the seismic belt south of the equator. And, sure enough, before he reached Japan, came the shocks which were so disastrous to Valparaiso, in Chile.

Then came the earthquake in Mexico in 1907, this time equidistant from both San Francisco and Chile, and, oddly enough, less violent than the Valparaiso one, as that was less violent than the California catastrophe. Reasoning from this, it would not be improbable that the next shock, following upon the Italian one, would be in the same belt, but in the Himalaya district, while a third successive shock should still later be felt in the Caucasus, midway between the two.

Scientists long ago recognized that earthquake zones are also zones of active volcanoes. This is particularly true of the Italian (Mediterranean-Alps) section of the first belt spoken of above, and of the Pacific Ocean belt. Italy shows the sudden activity of the volcanic system in the neighborhood ; and invariably, great tremors in Japan are followed by volcanic explosions of fearful intensity.

For this reason it has been popularly supposed that earthquakes have their origin in volcanic disturbances. Of course, it cannot be denied that the coincidence is a striking one, yet the relation of earthquakes to volcanic action is not that which had been generally supposed. It is true that both have their origin in the same neighborhood ; and this neighborhood is usually one where mountains have been built up by the cooling of the earth, and the consequent wrinkling of its surface. But to-day it is only where mountains are still growing, where they are being fashioned and re-fashioned, that earthquakes and active volcanoes are to be found together. In those places vast areas are tossed about by internal action and the squeezing which attends this process usually forces out molten rock matter through the volcanoes.

When the mountains have ceased to grow lava is no longer exuded through volcanoes ; but earthquakes are possible where the earth is "dead," as was the case in California. De Montessus, the great geologist, says : " While we may cite regions frequently shaken by earthquakes which, at the same time, have their active volcanoes, the fact should be recognized that there is independence of the seismicity and volcanicity ; that while there is coincidence between the unstable regions and eruptions, one phenomena does in a marked degree cause the other."

It is true that the volcanic and seismic histories of the same province show that unusual earthquake intensity occurs at the same time as excessive volcanic activity. During the great Calabrian earthquake of September 8, 1905, the greatest for a century for that neighborhood prior to the present one, the neighboring volcano, Vesuvius, showed not the slightest sympathy. Eight months later, however, there occurred in it the greatest eruption in almost three centuries. Going back to the fearful earthquake in Calabria, in 1783, we find that both Etna and Vulcano only became active after some time. It would seem, then, that the underground changes producing earthquakes are responsible for the throwing out of masses of matter through the fissures called volcanoes.

Italy, although a heavy sufferer through earthquake and volcanic disturbances, has not been alone in frequently paying toll in lives to earth tremors. The lower valley of the Tagus, upon whose bank the city of Lisbon is built, has a long record of disastrous earthquakes, the most noteworthy of which were those of 1309, 1531 and 1755. Until the disaster at Messina the Lisbon horror of 1755 took first rank, in many respects, among all recorded earthquakes. The first shocks of this earthquake came without other warning than a deep sound resembling thunder, which appeared to proceed from beneath the ground, and it was immediately followed by a quaking which threw down almost the entire city. In six minutes sixty thousand people perished. The day was almost immediately turned into night, owing to the thickness of the dust from the shaken city and the ruins quickly took fire, so that to the destruction from the shocks were added the horrors of a conflagration and pillage by bands of robbers. The new Lisbon quay, which had been built entirely of marble, suddenly sank into the sea with an immense crowd of people, who had gathered in supposed safety upon it, and the accounts state that not one of the bodies ever floated to the surface.

Following hard upon the first shocks, the sea retired from the land, carrying boats and other craft with it, only to return in a great wave 60 feet in height, which completed the destruction in

and about the city. This great sea wave, which was, until that which recently wrought such havoc in Italy, the mightiest which has ever been described in connection with an earthquake, not only swept the coast of the Iberian Peninsula, but extended with destructive violence to the coasts of many distant countries. At Kinsale, in Ireland, it was strong enough to whirl vessels about and to pour into the market place.

The present scene of disaster, Calabria and Northeastern Sicily, has a long record of shocks; and for no other country save Japan have the records of local earthquakes been so long or so well preserved. The areas shaken have not been extraordinary for extent, but as regards both the changes in the country produced and in the loss of life which occurred they rank among the greatest in history. The shocks of 1783, which cost 30,000 lives, came without warning, and in the space of two minutes threw down numberless cities and villages. Here again there was a tidal wave, and 1600 people who sought safety on crafts were destroyed by it. The coast outline has been changed by every quake; in fact, there is no such thing as a permanent coast outline near Calabria.

The Empire of Japan is, as regards its land area, perhaps as unstable as any upon the globe, and the records of its earthquakes are probably as complete as any that are in existence. The total number of recorded destructive earthquakes in a period of nearly 1500 years is 223. Since the beginning of the seventeenth century the records prove that a destructive earthquake has occurred somewhere in the Empire once every two and a half years. The earthquake of October 28, 1891, shook an area of 243,000 square miles, or more than three-fifths of the entire area of Japan. Without the least notice the stroke fell, and in thirty seconds there followed a destruction of 7000 lives and 20,000 buildings, while 17,000 people were more or less seriously injured.

In 1897 occurred the earthquake of widest geographical extent yet recorded. It was at Assam, India, and in two minutes and a half destroyed everything within an area of 150,000 square miles, and shook with more or less violence some two million square miles.

The United States has a list of shocks, which have in several instances been very disastrous. The earthquake of 1811 along the Lower Mississippi River was felt throughout the United States, and between December of 1811 and March of 1812 not less than 1874 shocks were recorded in the Mississippi Valley. The neighborhood of New Madrid, Mo., never entirely ceased shaking, and rumblings are heard to-day.

In 1886 came the quake along the Atlantic seaboard. Before the eventful August 31, 1886, few, if any, of the inhabitants of the quiet city of Charleston, S. C., had the slightest idea that they stood in danger from earthquakes. Yet the Atlantic seaboard is a place of relatively high seismicity. In that earthquake of 1886 the casualties were few, although 14,000 chimneys were destroyed.

The California earthquake of April 18, 1906, is likely to be memorable because of the value of the property destroyed and the interest it aroused in Americans as to the danger from earthquakes in our own country. It is a fact, for instance, that New England is a province of rather high seismicity, although no earthquakes of destructive violence have been recorded. The same statement applies with almost equal force for the entire Atlantic coast from Nova Scotia to Georgia. Other districts of the nation which are especially likely to be disturbed are the Central Mississippi Valley, the valley of the St. Lawrence and large areas not as yet well determined in the Great Basin and Pacific coast regions of the Western States.

With the advent of recent self-registering instruments all others have passed out of use. The seismograph is in principle a finely suspended pendulum, usually of considerable weight, whose motion operates a series of levers, which in turn make marks on a piece of paper mounted on a revolving drum. All the complex seismograph instruments are varieties of this type. The pendulum only records earth motions, and is so balanced that its swings are not kept up except by a continuation of the earth tremors, whereas an ordinary pendulum would keep on oscillating if started.

Seismographs are housed in cellars, and if used to record delicate, distant shocks are brought in contact with the rock under-

lying the soil of the cellar. In the construction of such a cellar care is taken to keep the locality distant from railroad tracks or streets of heavy traffic. Seismographs which are used to study local shocks of great intensity are placed on loose soil, since it serves better to lengthen out the record of a sudden shock.

The countries which have been the greatest sufferers through earthquake shock have produced the ablest seismologists—Japan and Italy. The Italian station is at Rocca di Papa, near Rome, and almost all its instruments have been designed by its distinguished director, Professor Agemennone. The real Italian head is Professor Palazzo, of the Central Office of Meteorology and Geodynamics, who co-ordinates the work of fifteen stations of the first rank and controls 800 seismic correspondents.

Japan, with its relatively small territory, has at present, in addition to its Central Meteorological Observatory, and the Laboratory of Seismological Institute of the Imperial University (both at Tokyo), 71 local stations provided with seismographs and 1437 other stations scattered throughout Japan.

America is far to the front in this respect. Great Britain does important work in its many possessions scattered over the world. Germany has twelve earthquake stations, in addition to the chief station at Strasburg, where may be found the highest development of instrumental refinement in earthquake study.

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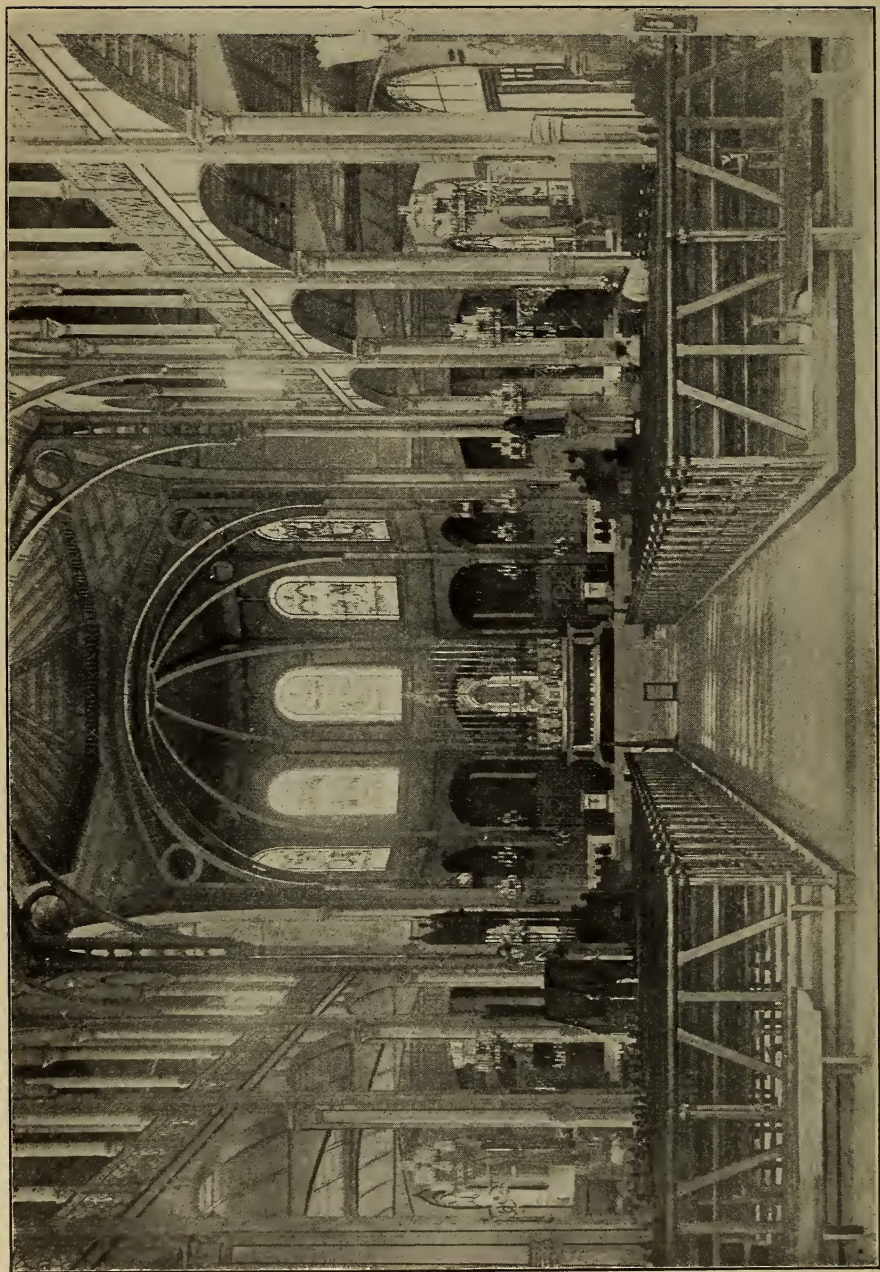
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An illustration of a woman in a long, dark, draped dress leaning over a stone monument. The monument has a columnar top and a base with the words "IN MEMORIAM". The background shows a landscape of ruins, including a large dome and other structures, with smoke or clouds in the sky. The foreground is filled with debris and rubble.

IN MEMORIAM

OF
ITALY'S
DEAD

DECEMBER 28TH
1908



INTERIOR VIEW OF A MAGNIFICENT CATHEDRAL THAT WAS DESTROYED.

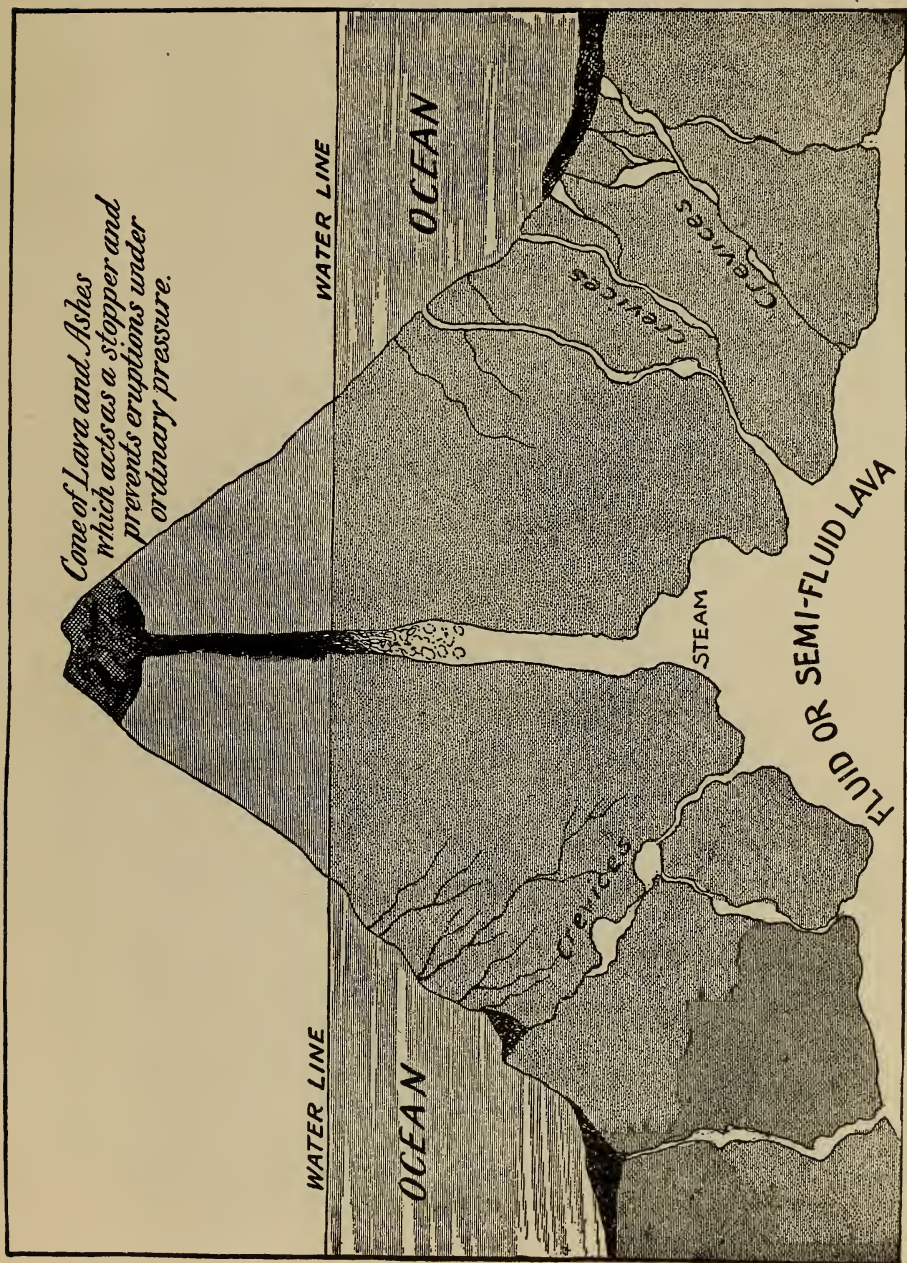
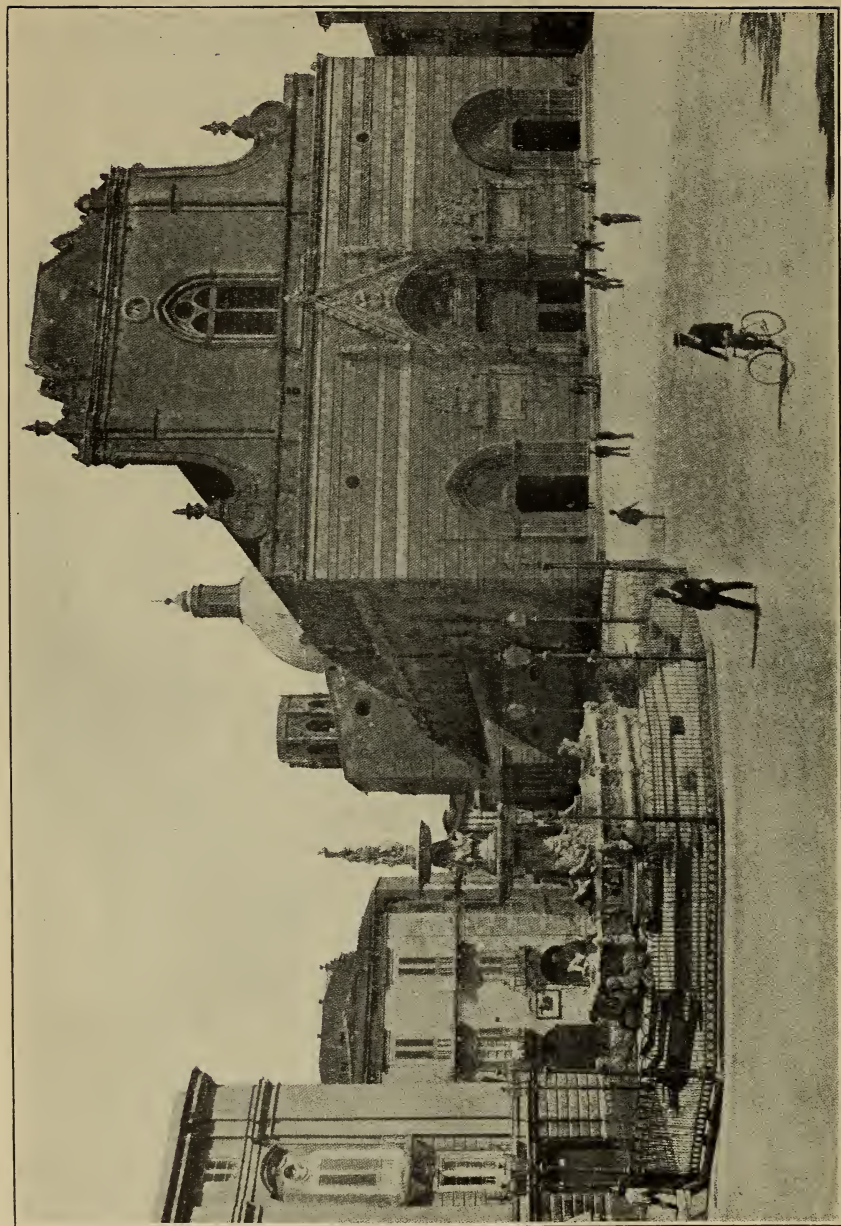
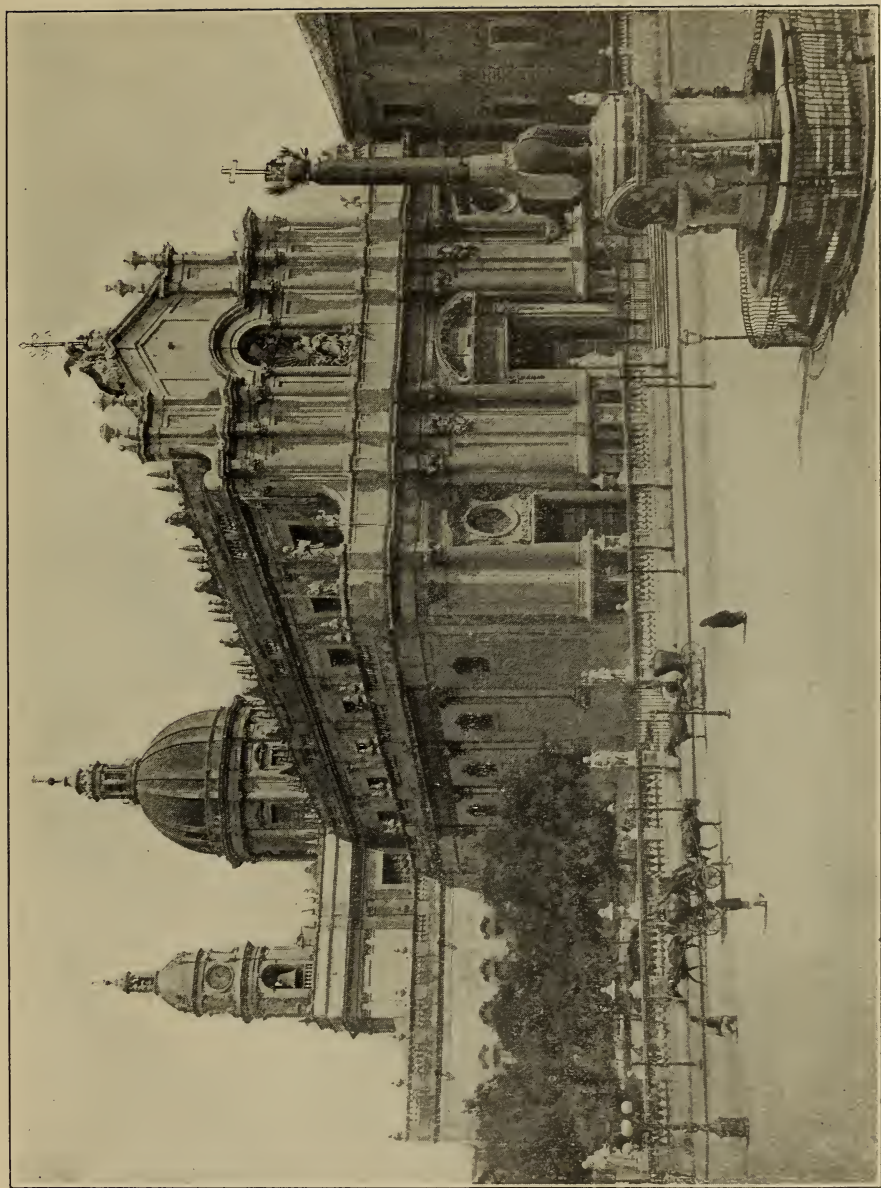


DIAGRAM SHOWING HOW VOLCANIC ERUPTIONS ARE PRODUCED

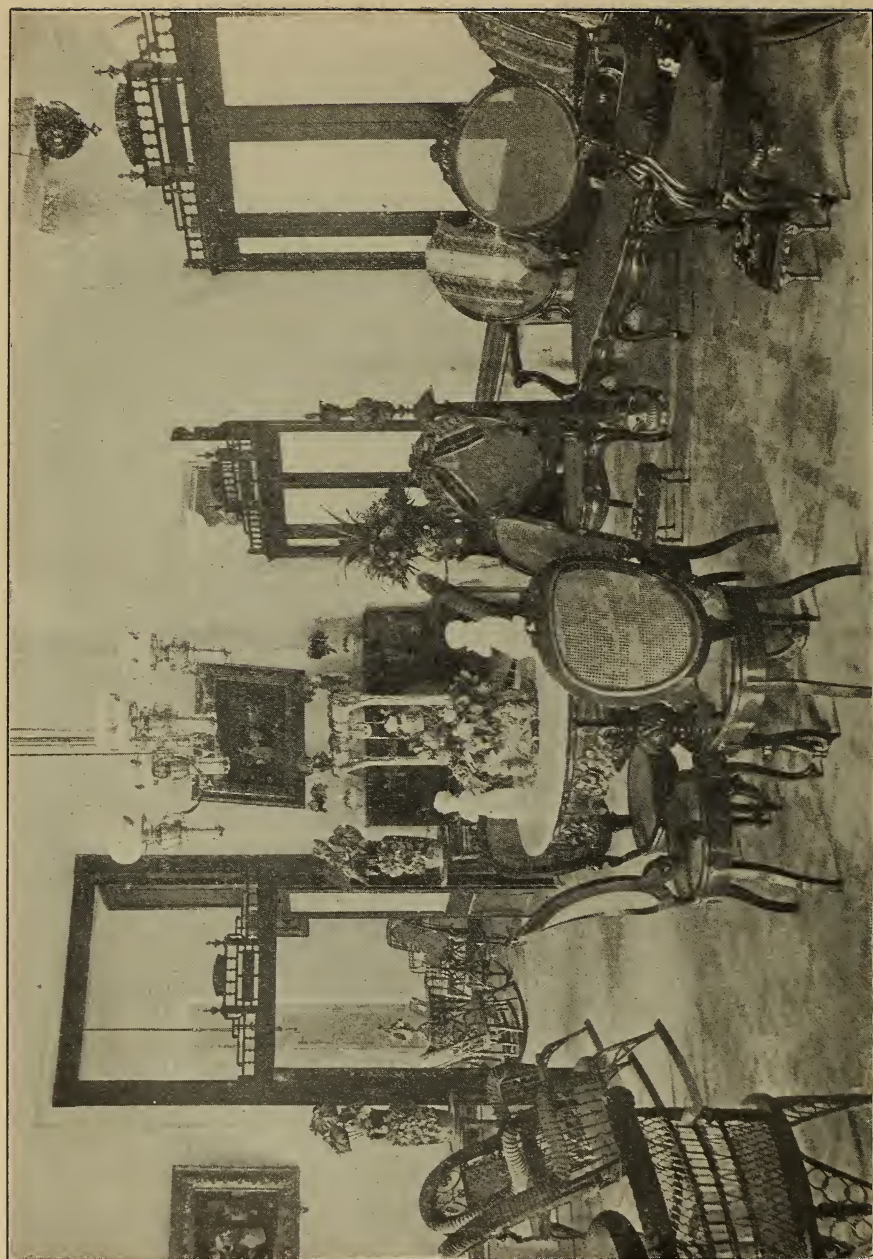
WATER COMING IN CONTACT WITH MOLTEN LAVA IN THE VOLCANO'S INTERIOR GENERATES STEAM AND CAUSES AN EXPLOSION
AS STEAM DOES IN A WEAK BOILER



CATHEDRAL AT MESSINA,
SHOWING FOUNTAIN, DEL MONTORSOLI, IN THE FOREGROUND



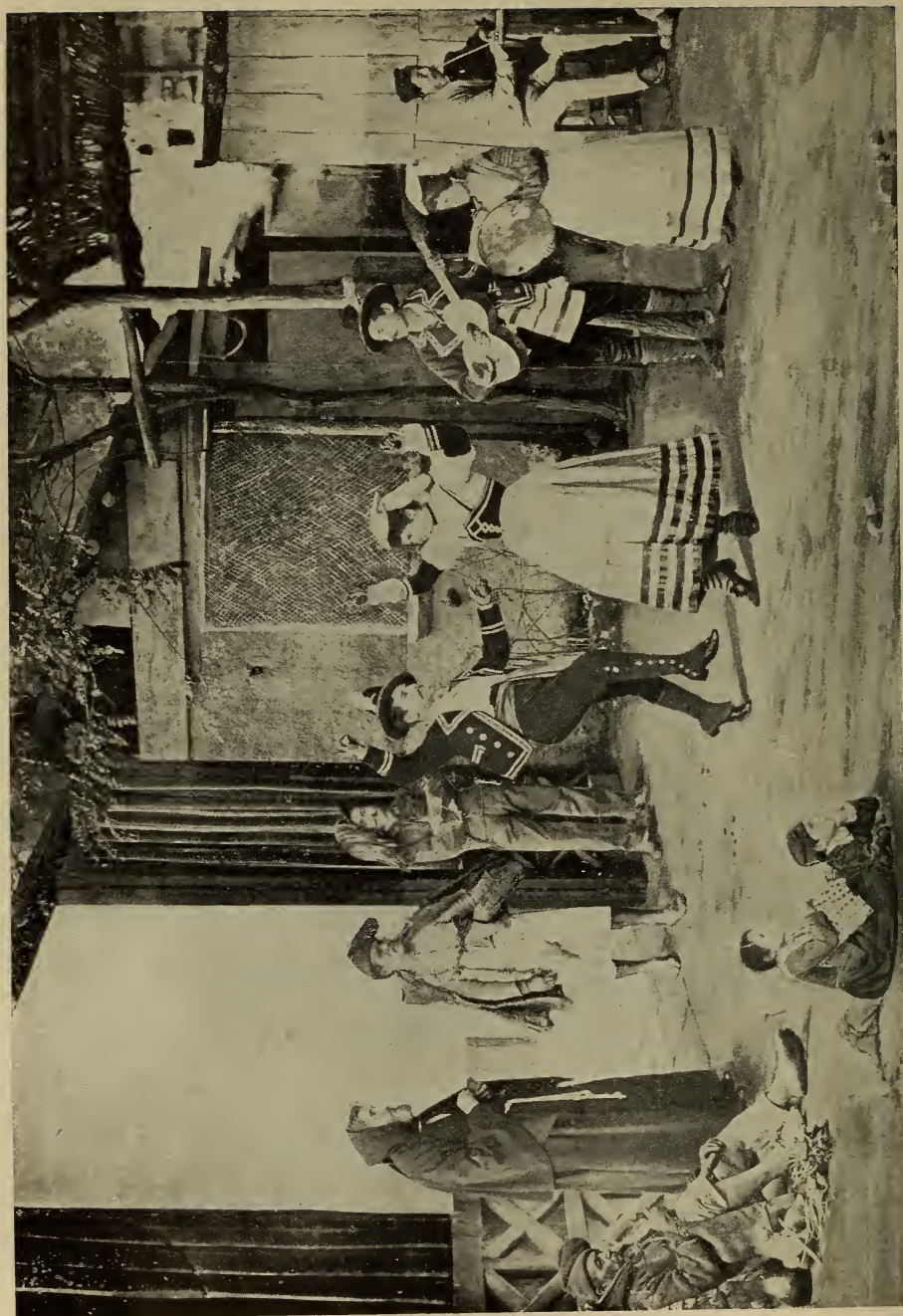
VIEW OF THE CATHEDRAL AT CATANIA, SICILY,
CATANIA WAS SWEEPED BY TIDAL WAVE, CAUSING GREAT DESTRUCTION OF PROPERTY AND LOSS OF LIFE.



INTERIOR VIEW OF RESIDENCE OF A WEALTHY MERCHANT OF MESSINA.

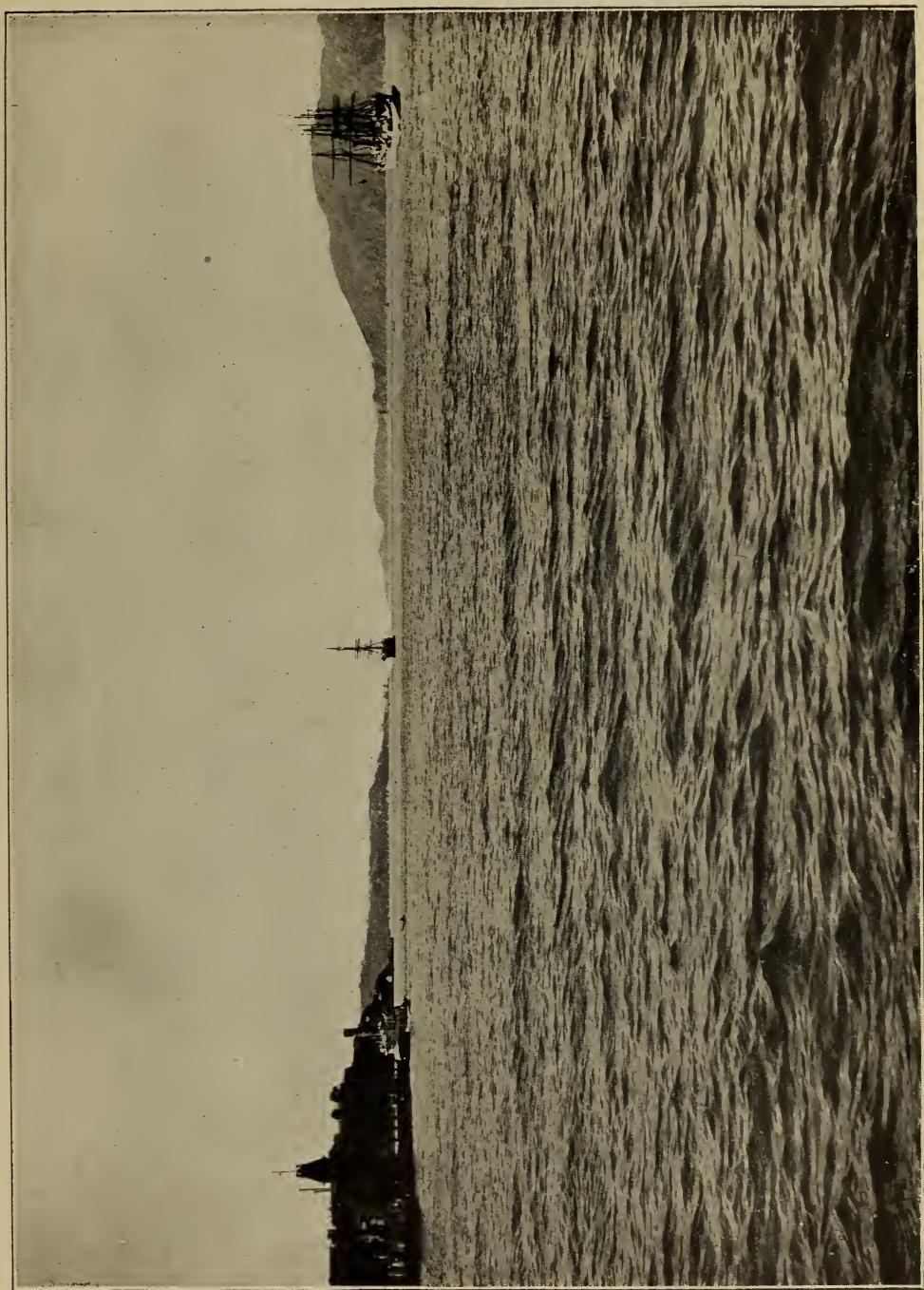


SCENE IN THE FRUIT MARKET AT MESSINA

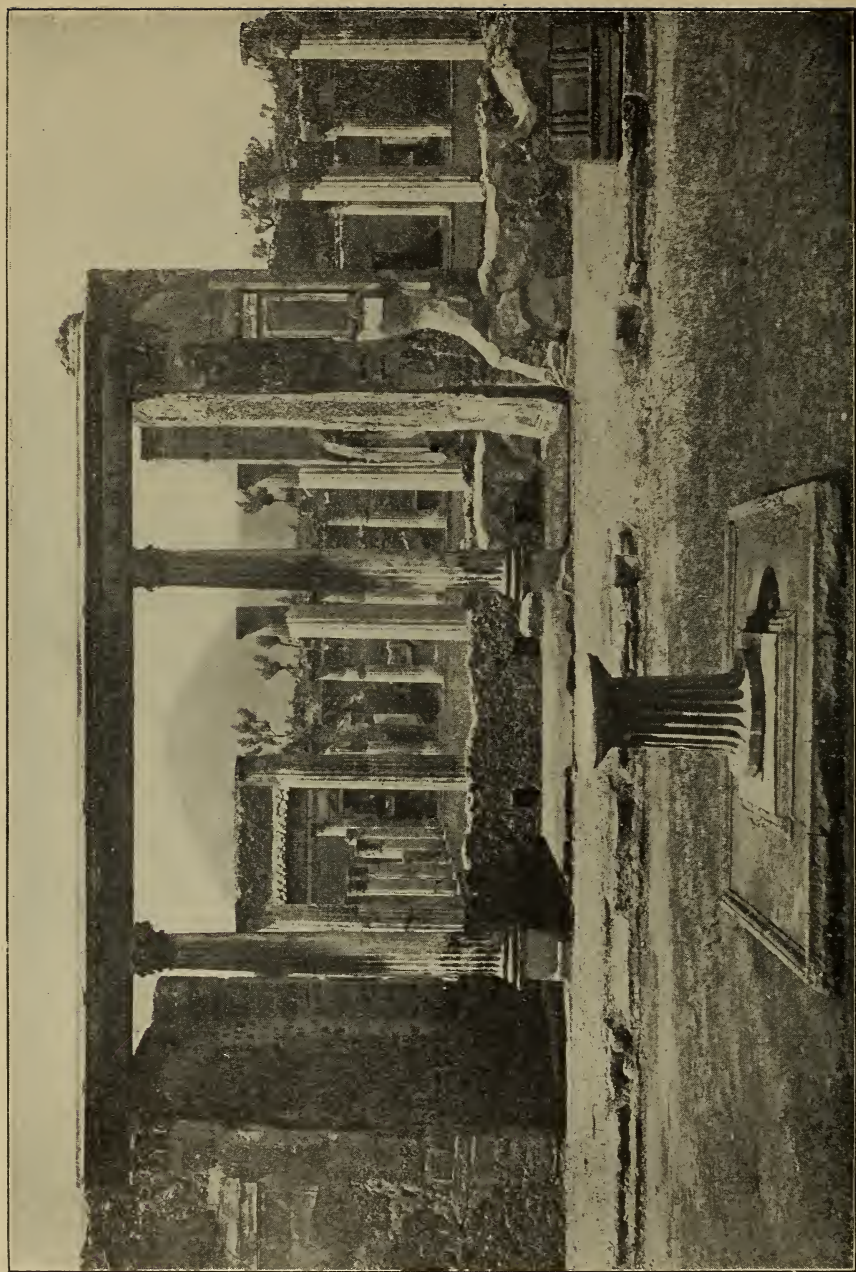


THE TARANTELLA DANCE, SOUTHERN ITALY.

THIS DANCE IS SO CALLED FROM A POPULAR NOTION OF ITS BEING A REMEDY FOR THE POISONOUS BITE OF THE TARANTULA.



STRAITS OF MESSINA, WHICH SEPARATES SICILY FROM ITALY.



RUINS OF HOUSE OF THE FAWN, POMPEII—SHOWING MOUNT VESUVIUS
IN THE DISTANCE



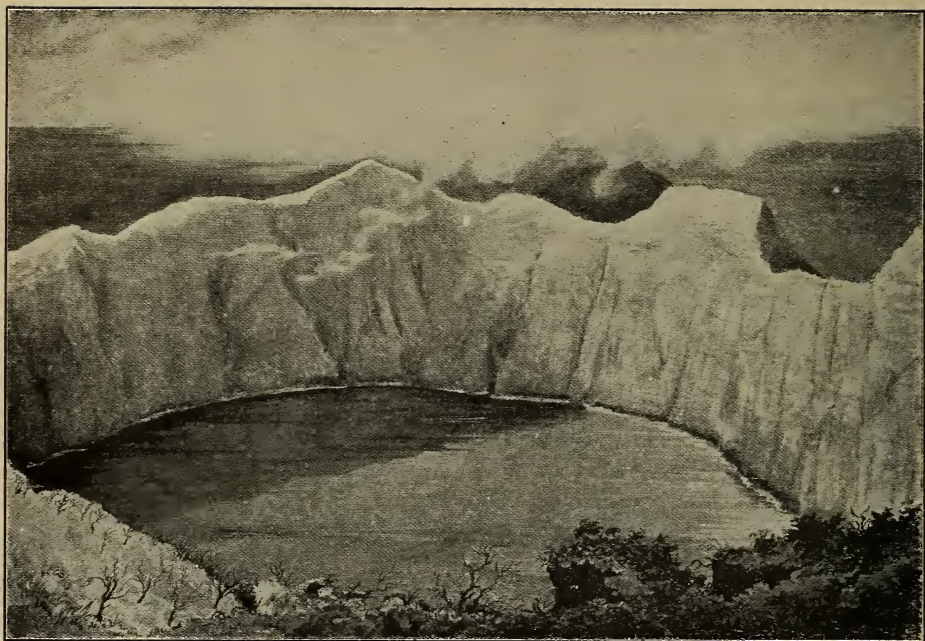
EXCAVATED PORTION OF THE STREET CALLED STRADIA IN POMPEII, WHICH
WAS BURIED UNDER THE ASHES



STREET SCENE, REGGIO, CALABRIA.



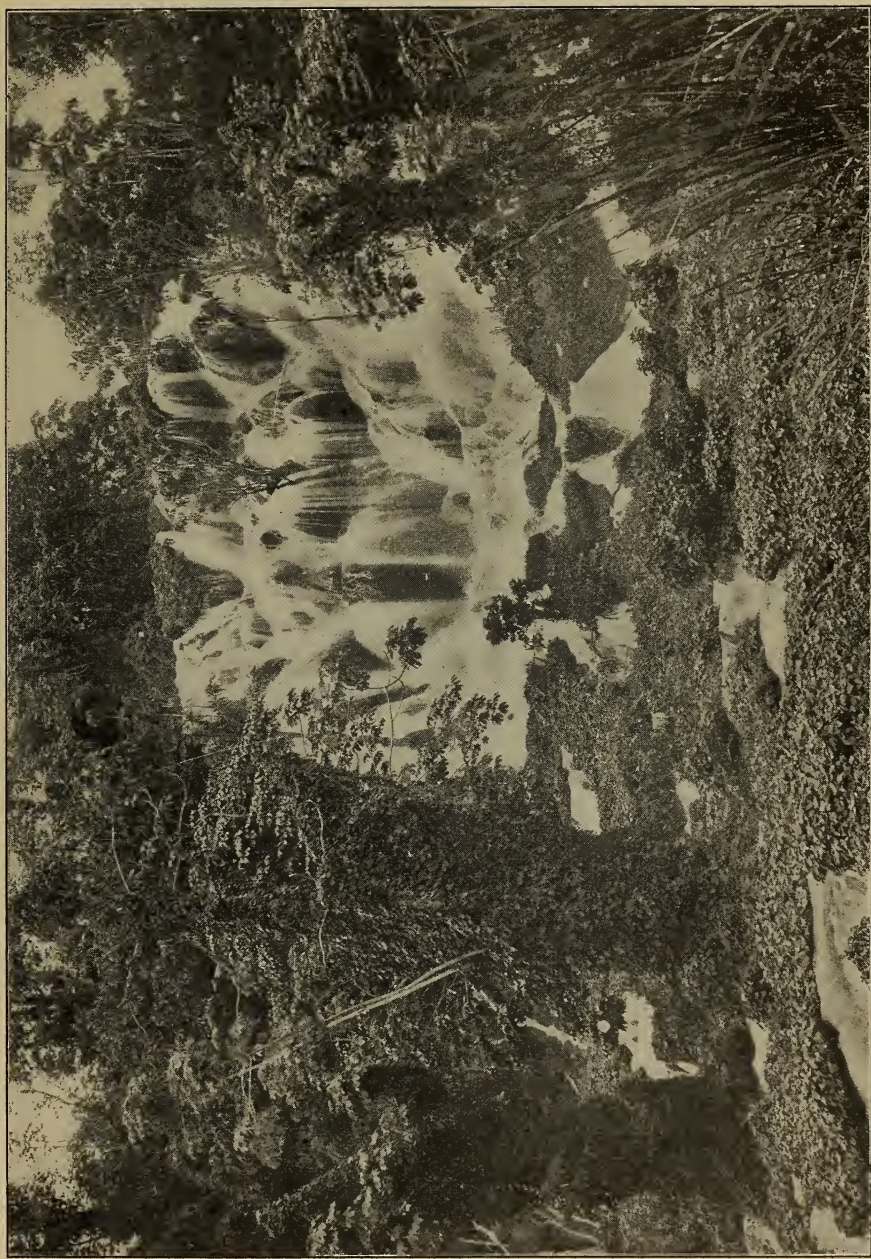
WOMAN OF SICILY DRESSED FOR THE CARNIVAL.



THE CRATER OF MOUNT SOUFRIERE, ST. VINCENT. THE ERUPTION
OF WHICH DEVASTATED MUCH OF THAT ISLAND



SCENE OF THE TERRIBLE CALAMITY IN MARTINIQUE, WHICH
CAUSED THE DESTRUCTION OF ST. PIERRE



FAMOUS WATERFALL NEAR MESSINA IN SICILY



SCENE ON A COUNTRY ROAD NEAR REGGIO IN CALABRIA.

CHAPTER I.

THE HORRORS OF THE EARTHQUAKE AT MESSINA.—CITY SLEEPING WHEN DISASTER CAME.—CRUSHED IN FALLING HOMES.—DRAMATIC SCENES.—THE TIDAL WAVE.

THE hour was early dawn. Messina, the centre of the greatest disaster of historic times, lay sleeping on that fatal 28th day of December, 1908.

That faint chill which comes to the semi-tropic lands in the waning hours of a mid-winter's night was in the lazy air.

The Mediterranean lay like a sea of glass beyond the breakwater. The faint breath of breeze that crept over its waters from the northwest was scarcely sufficient to ruffle its placid surface.

Etna's lava-scored but vine-clad slopes darkened the southern horizon, while from its snow-capped peak, reared 10,000 feet into the heavens, a thin wisp of smoke, gilded by the eternal fires in the death-dealing crater below, floated idly off to the southeast.

The hour was dawn, but not a ray of light came from the heavens to banish the foreboding pall that hung like a sable shroud over the doomed city.

The wide streets, with their myriad of gleaming lights, were deserted save as here and there a belated straggler, muffled to keep out the unwonted chill, hurried to the early mass in some one of the city's majestic churches.

In the capacious harbor scores of vessels swung idly at anchor.

The silence was unbroken save for the muffled tread of the sentries on the ramparts of the citadel and the lesser fortresses that dotted the water front.

The city slept.

In massive palaces and humble hovels alike men, women and children lay wrapped in a slumber from which they were so soon to start in terror only to be plunged anew into that sleep that knows no waking.

Tired and worn in body and mind alike by the holiday revels they

dreamed on. No foreboding of their impending doom cast its dread shadow over their couches.

All nature seemed at rest and at peace.

Suddenly out of the skies came a sinister hiss that caused the very priests at the altar to halt in their sacred offices. Heads bowed in prayer were raised as the hiss deepened into an unearthly shriek. The kneeling worshippers leaped to their feet for one brief instant and then slowly and reverently, but with an added touch of terror, again sank to their knees and began to feverishly finger their beads.

Crash! Bang!

The heavens thundered as from the bursting of ten thousand bombs.

The hiss deepened till it seemed that a myriad of red hot serpents were writhing in the waters.

Then came the whirl, the rush and roar of a torrential rain so terrifying that not a face but blanched with apprehension. Only those who have faced an electrical storm in the tropics can imagine one hundredth part of the horror of that supernatural demonstration.

THE EARTH BEGINS TO QUIVER.

The earth began to pulsate. Slowly and in rhythmic measure at first as though trying its strength and then with a wild and frenzied burst like the dance of a million imps. It rocked not only Messina, but half of Sicily and all of Calabria like a raft in a storm.

It lasted but an instant, but in that brief span scores of thousands perished 'neath the ruins of the stricken city.

The first crash from the heavens reached every ear in Messina.

The houses had begun to vomit terror-stricken men, women and children before even the fantastic dance of earth began.

Full well did those who dwelt in the shadow of majestic but death-dealing Etna know what the artillery of the heavens portended.

Science may present its theories. Those who dwell in the shadow of death have no use for them.

Ages of calamity had taught those men of Messina that earth and heavens act in harmony and that the rattle of the thunder and the roar

of the tempest was but a prelude to a drama of death in which the very earth beneath their feet was to sway like the waves of the sea.

Thousands gained the open streets before the final crash came. Walls fell to the right of them; roofs crashed to the left of them; cornices and chimneys toppled before them, while death stalked in their wake to destroy any who hesitated or paused. Other countless thousands were too late or were held prisoners of jammed doors and fallen stairways.

The earth shook itself in one great convulsive movement as though the giant whom tradition says Jupiter ages ago imprisoned beneath the massive rocks of Etna was struggling, after centuries of confinement, to break his bonds.

DEATH WROUGHT BY DISASTER.

Walls shivered, gaped and fell, carrying down to death all who still clung, with convulsive fear, to their racked and ruined homes.

Beams groaned and creaked, as if in mortal agony, and then at the final and supreme moment, slipped from their sockets in the walls. Roofs crashed to earth, carrying down with them the massive arched floors beneath.

Even all of those who had sought safety in the streets did not escape. In many of the narrower thoroughfares the debris piled many feet deep from curb to curb, burying under countless tons of stone and mortar not only those who in their terror had taken shelter in their shadows, but the fleeing hordes who, maddened by the terror of that awful moment, had sought safety in flight.

Still other walls, relieved of the burden of roofs and floors, hung tottering, seamed and scarred by the terrible forces of the cataclysm.

Crash!

The very heavens seemed appalled and the low-hanging clouds reflected back the sound.

"Dies Irae," the day of wrath, screamed a thousand throats.

The great gas tanks, at the northern end of the town had blown up, and before the force of that terrific explosion the tottering and hesitating masonry crashed prostrate to the dust, burying hundreds of al-

ready cut, bruised and battered human beings in the only tomb most of them will ever know.

In this crash the Capucine Convent fell, while hundreds perished.

Within the churches was to be found the nearest approach to serenity in all that stricken city. The black-frocced priests hesitated but a moment, and then, grasping the sacred hosts in their hands, slowly and with even more than usual reverence resumed their chants till the loosened beams and seamed and gaping walls let tons of death and destruction down upon the flaming altars, burying priests and people alike in the depths of a funeral pyre.

The gas lamps flared for the brief instant of the explosion like the last dying flicker of a candle. Then they went out, leaving the streets in utter darkness.

In the horrible wrenching and grinding and twisting of the earth the electric wires broke, and a million hissing serpents, spitting death, coiled about the panic-stricken survivors.

Again the ground trembled and the earth yawned in hideous fissures that seamed the streets like giant mouths, hungry to devour the panic-stricken and the helpless.

WATER MAINS GUSH FORTH DEATH.

The water mains parted and the reservoirs gushed forth death and devastation.

Meanwhile the cold rain from the north, driven by a wind that had risen to the heights of a hurricane, mercilessly beat upon the helpless and hopeless survivors.

Yet, blindly groping in the almost Stygian blackness to which the dust clouds from the fallen buildings gave added depth, the scarred and stricken survivors plunged on to the open spaces where they felt that safety lay.

In the mad panic few stopped to consider direction save as it carried them to the broad esplanade that lined the harbor, and away from the Etna of which centuries of peril had ingrained fear into their very beings.

Climbing over seemingly impassable barriers of broken stone and

twisted and tangled beams, daring death in the shadow of a hundred tottering arches, slinking along in the shadows of seamed and scarred masonry, thousands finally made their way through those acres of desolation and death to the water front.

In the capacious square that lay open between the great citadel, the railway station and the massive warehouses and palaces at the southern end of the harbor tens of thousands struggled for places as far from menacing walls of masonry as possible.

In the smaller square fronting the great cathedral and in the shadow of its massive walls other thousands clustered for safety.

Proudly and defiantly the great cathedral had stood the ravages of two great fires and countless earthquakes for nearly a thousand years, ever since the Norman conqueror, away back in the eleventh century, had shown to classic Sicily the solemn beauty of the Norman-Gothic architecture.

IN THE DOOMED CATHEDRAL.

So far through all the centuries, it had not failed those who had fled to it for safety. At its high altar alone of all the churches in Messina, the solemn chanting of the mass was still giving hope in the midst of devastation, destruction and death.

Vain hope!

The grim reaper had not yet taken his full meed of human sacrifices. The grand old structure, the noblest and most noteworthy in Messina, which had sheltered their forebears through many a siege of destruction was now, for the first time, to prove unworthy of the trust reposed in it.

Already its scarred walls, weakened by the stress of the centuries, were seamed and cracked by the tumultuous writhings of the earth.

Again its foundations trembled and its massive walls, as though soul-weary after its age-long fight, crumbled to the dust.

The university, the almshouse, the municipal hospital and the custom house already had fallen.

The great commercial structures that lined the docks to the south and the palaces that fronted the open sea to the north already were shapeless heaps of stone and mortar, with here and there a wall rising like a grim sentinel guarding a city of the dead.

The Trinacria and the Victoria hotels, with their hosts of tourists of all nations, crashed into mounds of ruins over what were in grim truth the graves of hundreds.

The Theatre Victor Emanuele and the Theatre della Munizione, two structures of the highest class, were scarred and battered, their roofs fallen in and heaps of mortar defiling the plush and brocade where, but a few hours before, grace and youth and beauty had smiled away their last happy hours.

NOBLE STRUCTURE DESTROYED.

The massive antique columns of the Church of the Annunziata dei Catalani, another grand old Norman structure, tottered and fell, crushed and broken, while the entire facade of the noble structure, wavering for a brief instant, swelled the mass of shapeless fragments.

The American Consulate, too, fell at the first great shock, burying the Consul, Arthur S. Cheney, and his wife. Another American who was killed was Joseph H. Peirce, former U. S. Vice-Consul, who with his family were crushed to death.

The entire family was asleep when the first shock came, according to the rictal of Miss Evelyn Peirce, a cousin of Mr. Peirce, who was safe at Naples. Mr. Peirce was the first one to realize the terrible shaking as an earthquake. He urged his wife to take the younger children and make her escape. He then rushed into the room where the elder children were sleeping to arouse them, but the tidal wave rushed in and completed the work of destruction. The tottering walls of the Peirce house collapsed and the entire family was buried beneath the ruins.

Mr. Peirce was the Messina correspondent of the Associated Press.

Among the buildings wrecked was the barracks of the carabinieri, in which 50 perished in the ruins.

A palace of 26 rooms collapsed and of the inmates only four escaped.

The seaward fronts of the University and Palazzo Municipale remain standing, but the interiors are gone. The buildings along the waterside collapsed like houses of cards.

The Santelia barracks were destroyed with most of the troops in them, only thirty soldiers escaping out of 230.

The immense military hospital was wrecked, with its sick and convalescents in it.

The prison collapsed and buried 400 prisoners, while 30 or more made their escape. Many officers of the garrison later were removed from the ruins still living, but almost all of the guards, in the less substantial portions of the building perished.

SOLDIERS DIE IN RUINS.

The barracks were demolished. The commander of the troops was killed outright, and there are many victims among the enlisted men.

Yet from all this wild carnival of death thousands escaped to the Avenue Palazzati, that skirts the inner shore of the harbor, in a frantic endeavor to escape the hail of bricks and mortar that were still raining death, at every tremor, upon the refugees.

Vain delusion. The story of slaughter was not yet half told.

Another, and, it might almost be said, even greater calamity, was impending.

There, in the open places, in the rain, bleeding from their wounds, nursing their hurts, the refugees huddled, praying for the coming of the day.

Numbed with the horror of the situation, some mumbled prayers, while others, crazed by the shock and the loss of loved ones, danced and sang.

The scene was unparalleled in all human experience.

Agony was yet to be piled upon their misery. Disaster was yet to come. Death's hideous carnival had but just begun.

Agony was yet to be piled upon their misery. Disaster was yet to be piled upon their misfortune. The dreadful forces of nature, having tasted blood, had but had their appetites whetted, and now were about to demand fresh victims.

The few soldiers who still clung to the shattered ramparts of the fortresses along the breakwater were the first to give the warning.

But it came too late, either for themselves or the hosts who lined the esplanade along the water front.

In the growing brightness of the dawn they saw what yet was hidden from those lower down along the water's edge.

Rearing its head fifty feet in the air a giant wave was racing from the Calabrian shore. They did not know, could not know, that already this same wave, first sweeping to the eastward, had engulfed Reggio di Calabria, a city of 50,000 people, eight miles to the southeast on the Italian mainland, across the Straits of Messina and that rebounding from the Calabrian cliffs it was returning to wreak a further vengeance on stricken Messina.

Those to the north, beyond the end of the breakwater, saw it almost as soon as the survivors in the forts.

In an instant there was a wild rush for safety, back across those hideous piles of ruins, while the groans of the injured, hopelessly pinioned beneath beam and brick, added to the horror.

None then thought of succoring the injured. Self-preservation is nature's first law and self-preservation was possible only by flight.

It seemed but a moment before the hissing wave, speeding along with the fleetness of a race-horse was upon them.

BATTLING IN THE VORTEX OF THE TIDAL WAVE.

Men, women and children again had a battle with the most diabolical forces of nature for their very lives.

The wave, 50 feet high, rolled back three blocks from the shore line and in its waters thousands met that death they had so miraculously escaped in the vortex of falling walls and crashing masonry.

Hundreds of half-dressed men, women and children who had fled from their houses to the streets were caught in the onrush of waters and drowned or injured.

In a moment it had receded, carrying with it many of its unhappy victims, while the bodies of hundreds of others strewed the strand.

Flames then began making their way slowly over the devastated area in an inexorable advance. Imprisoned and pinioned human beings, unable to extricate themselves, burned alive, hundreds were dying of their injuries, while many were starving.

The streets were filled with confused masses of brick and mortar,

beams, furniture, chimneys and roofs. In many cases the streets appeared as enormous crevasses, twisted into fantastic shapes.

The celebrated avenue, which runs along the inner sea front from the university to the postoffice, was impassable. All the public monuments that were there had disappeared.

All the water pipes, sewers and gas pipes of the city had been destroyed, and water and filth were flooding the torn streets. Gas explosions occurred frequently, and resulted in scores of small fires.

CRYING NEED WAS DOCTORS.

For several hours after the first destructive shock Messina was absolutely without organized relief. The municipal officials, the soldiers, the police, doctors and nurses by the hundreds were either buried or drowned.

The first work of rescue was performed by volunteers from ships in the harbor and groups of survivors who, at great labor and personal danger, extricated many persons pinioned beneath the wreckage.

Messina's crying need was for doctors, clothing and food and firemen to combat the flames.

Doctors, nurses and firemen were hurried into the wrecked city, but the lack of food and water made the work of rescue difficult. The Russian and British warships at Messina sent crews ashore, and the vessels were transformed into hospitals.

All the hospitals in Catania were crowded, and even the schools were converted into infirmaries. The less seriously injured of Messina were dispatched by the dozens to Palermo.

Minister of Public Works Bertolini arrived, and organized several corps of volunteers for rescue work.

Refugees telling of their escape, relate that after escaping from their ruined houses they waited in terror for the coming of light. Then they made their way over the obstructions in the streets to the open places. They had to leave behind them under the ruins countless victims who called for help in heartrending tones.

It is asserted that probably half the fatalities occurred because it was

impossible for the survivors to render prompt assistance. Not the least of the suffering was caused by the downpour of cold rain.

The waters of the Straits of Messina were covered with the floating bodies of men and animals and all kinds of wreckage. More than 300 vessels were adrift off Messina alone, while hundreds of others lay on the bottom of the troubled sea.

In Messina crowds of nude persons walked the streets with images of saints. They all appeared demented. From the stricken city five huge columns of smoke could be seen rolling heavenward.

All the towns and villages along the Straits were rapidly becoming depopulated, as there were widespread fears of further convulsions.

ESCAPE OF A DEPUTY.

Scenes of the weirdest nature were being enacted at Messina and other ruined cities. Clouds of crows and buzzards descended on the stricken district, having crossed the sea in response to some mysterious intuition of the disaster.

The roads between Palermo and Messina were filled with long, sad processions of wounded refugees, painfully making their way to the westward. They all believed they were the only survivors.

The wife of the French consul at Messina, the sole survivor of her family, finally reached Milazzo. She was badly injured. Her husband, son and daughter were killed.

Ludovico Fuici, a member of the Chamber of Deputies, who was at Messina, at the time of the earthquake, gave an account of the death of his brother, Nicolo, who was also a deputy, and the efforts to save him, which was absolutely harrowing.

From 6 o'clock Monday morning until midnight he could hear the desperate lamentations of his brother and his anguished appeals for help, without being able to reach him, notwithstanding his frantic efforts. At midnight the groans gradually died away, and nothing afterward was heard.

Many of the wounded died before reaching Palermo, and many have died since they arrived.

Most of the refugees were practically naked; some in tattered garments picked up in the streets.

The stories related by the survivors in the hospitals and at the food supply stations, where rations were issued twice a day, all reflect the horror of the fateful 28th of December. There were many miraculous escapes, but the cases of bereavement are without number.

A cobbler named Francesco Missiano relates that immediately after the first shock he and his wife and children rushed out into the street. Fires were breaking out all around them. Hearing groans from a pile of debris nearby the cobbler made a hurried examination. He found two girls dying. The head of one was split open, while the chest of the other had been crushed in. The cobbler picked up a baby, but it expired in his arms.

It took his party hours to traverse the heaps of ruins between his house and the water front. After placing his family in safety he returned to seek his mother and sisters, but he was obliged to give up the effort. It was impossible to make his way back to his home.

During the thirty-six hours the cobbler passed among the ruins he did not see more than 5,000 or 6,000 survivors. This man owes his safety to the fact that he lived in a one-story house. He says that no help arrived for thirty hours after the catastrophe.

An old man who had lost all his family was seen going about the ruins vainly asking for food. He had loaded himself down with his most valuable possessions. While on one of the docks he suddenly called out:

"As nobody helps me, I will die," and with these words he threw himself into the sea. A sailor dragged him out.

CHAPTER II.

FIGHTING FOR FOOD IN THE RUINS.—FAMISHED BAND GROPE IN DEBRIS.—GHOULS FIGHT WITH FIREARMS.—SCOURGE YET TO COME.
—VANDALISM BREAKS OUT.

JUST as the British steamship Ebro was preparing to leave Messina with refugees an outburst of frightful cries was heard from the shore. The refugees on board saw a crowd of maddened persons of every age break into the custom house. Some were naked, others half clothed, and they all were mudspattered and half demented. Many were injured and bleeding. They sacked everything that came to their hands, seeking food, drink and clothing.

Bands of famished individuals were groping among the debris in the hope of discovering food. The first of the searchers who were successful were attacked by others with revolvers and knives, and were obliged to defend their finds literally with their lives.

The struggle was fierce. The famished men threw themselves upon each other like wolves, and several fell disembowled in defending a handful of dry beans or a few ounces of flour. One of the unfortunates was pinned to a plank with a knife, while clinging to his hand was a little child, for whom he had sought food.

Revolver shots rang out over the horrible din and confusion. Finally tongues of flame shot up in the darkness, showing that fire was completing the work of destruction.

This was only one of the many scenes of horror witnessed from the Ebro. Messina was burning, and masses of flames in the darkness showed where fire was completing the destructive beginnings of the earthquake. A few skeleton houses here and there were all that remained of the once beautiful and prosperous town.

Ghoul-like figures flittered in the semi-darkness, risking their lives among tottering ruins, not to assist the agonized sufferers, but in fiendish strivings to profit by the appalling disaster. They were robbing the dead and dying.

All of the survivors speak of the misery suffered by cold and hunger after their escape, and of the rarity of other survivors seen in the streets and open places, so that often they believed themselves to be the only persons saved; and of the dense, choking cloud of dust which hung over the city for a long time, obscuring their vision and adding to the horrors of their bewilderment; and of the greater horrors of the succeeding earthquake shocks, especially in the darkness, which seemed to forbid all hope of final escape. The worst time of all was the night of Monday. Few of them mention the effect of the seismic wave.

IMPRISONED IN RUINED HOME.

Perhaps the most tragic note was struck by an elderly couple, who described how they were imprisoned in the lower part of their ruined house. They could only cry for help and heard no answer, save other cries for help from the darkness around them.

At Messina it was impossible to pass through most of the streets, which were blocked with huge mounds of fallen debris. Here and there bodies, they said, could be seen in inaccessible places, pinned in by beams on masonry and projecting from the upper stories of the houses, sometimes lying half buried and horribly contorted.

In front of the city the sea wall was broken up and fallen and the sea walk was sunk under water. Behind this were streets upon streets of fallen houses. In some places the appalling scenes seem to beggar all description.

The correspondent of the Paris Figaro wired his paper about this time as follows:

"As each day goes by the disaster appears more horrible, terrifying and immense. It is without precedent in the history of the world. In my earlier dispatches I spoke of over 150,000 dead. This number doubtless will be exceeded, for now it is conservatively estimated that 200,000 persons perished miserably in this staggering catastrophe, and the worst is not yet known. The scourge has not yet done its final work.

"The tremblings of the earth continue with sinister rumblings, and at times jets of boiling water surge from the crevasses. The sources of the streams are poisoned with putrid matter.

"In spite of herculean efforts, the succor still is insufficient. In the more remote regions the unhappy injured are dying for want of food and medical treatment. Dogs and swine, enraged by hunger, spring upon the wounded and devour them. Insatiable fire and uncontrolled famine will inexorably claim their victims."

The Government hastily sent General Feira Di Cossatto, an army corps commander, to take full charge of the troops in the devastated territory. One of his first measures was to declare martial law.

VANDALISM BREAKS OUT.

Vandalism of the worst kind had broken out, and the Government adopted the most energetic and most severe measures for its repression. Robbers and looters were shot on sight.

As before narrated, the prison at Messina collapsed. Some of the prisoners were killed, but the survivors made their escape and joined the hooligans who were sacking the city. Such confusion reigned that the robbers met with no resistance. The local chief of police lay dead in the rooms of his office.

The robbers pillaged the ruins of shattered buildings, and even stole clothing and valuables from the corpses of the victims. They were not deterred by the flames that broke out in several sections of the city, but took advantage of the light for their vandalism. The night in Messina was one of horror indescribable—fire, robbery, dead and dying on every side, the city in the utmost confusion and the people panic-stricken and under a spell of terror.

Time only confirms the unspeakable horrors of the overpowering catastrophe.

History will, perhaps, never divulge its supremest individual tragedies, for earth and sea ruthlessly claimed thousands of human beings, and the flames mercilessly completed the unfinished devastation.

Heavy as was the toll of death in the great disaster, fully ten thousand, perhaps more, of the inhabitants of Messina escaped with their lives. Their stories will make history, yet few of them will show the wide perspective that the accounts of men aboard the ships in the harbor exhibit.

They saw the crash from a distance not too great for accuracy, yet still enough removed to lend an added touch to their words.

Among the first calm and collected stories of the disaster as viewed from the deck of a vessel in the harbor came from the master of the Welsh steamer *Afonwen*, whose unemotional British temperament enabled him to relate in detail his experiences and observations.

A TRAGIC RECITAL.

"During the night before the catastrophe," said the captain of the *Afonwen*, "we lay at anchor in the harbor of Messina under steam ready to leave early the following day. It may have been about 5 o'clock in the morning when I heard a low growling sound like distant thunder. Daylight had not yet dawned, but I was on deck and the crew were stirring. The peculiar sound made me glance anxiously at the sky and then at the sleeping town of Messina, neither of which afforded any explanation.

"Suddenly the *Afonwen* gave a terrific leap. That is the only word I can use. The ship seemed to rise up from the surface of the water as though lifted bodily by some mighty power underneath. The anchor chains snapped and we started to drift shoreward very fast.

"From the land came sounds of tremendous crashing and falling of buildings. The low, muttering thunder which I first heard now became a roar of destruction. All the lights along shore went out in an instant. The darkness was intense.

"Instinctively I knew this was an earthquake and that tidal waves were dashing us about the Straits. The first thing to do was to save the ship, for other craft were being thrown about on all sides and there was imminent danger of collisions. Another boat swept down upon us before I could get the crew to their stations and the *Afonwen* under control, but luckily the bump was slight and not much damage was done.

"Now the sea became tremendously agitated with waves and walls of water rising on every side. The ship listed to her beam ends. The deck heeled over to an angle of 25 degrees, so that we scarcely could keep our feet. For thirty-five minutes it was touch and go. Once a great

wall of water struck us with such violence that I thought all was over, but by a miracle we came through it.

"It was like a cyclone from all points of the compass. The wind howled and the waves battered and swept the decks. Amazing and terrifying things were happening all around us. Great holes opened in the sea itself and seemed to reach down twenty to thirty feet, and some at lesser depths.

"The water at first appeared to grow livid and then became white with foam.

"As soon as the worst of the tidal wave had passed I tried to see what had befallen the town of Messina as the first faint streaks of daylight appeared, but nothing was visible of mole or buildings. I could see at first only the outline of the hills and a vast eddying cloud of dust which speedily enveloped everything and settled down over the ship like a fog.

MESSINA'S BUILDINGS TOPPLE.

"With increasing daylight we could see how Messina had been destroyed. Before our eyes houses and palaces still were toppling and falling to earth with noise like so many exploding powder magazines. Close behind us a Danish steamer had gone down and the surface of the water was littered with all manner of wreckage from it and other wrecked craft.

"When we looked at the land again it seemed to have taken on some fantastic coloring—something between a yellow tint and an ashen gray. The city itself was black with smoke split by ominous red streaks of bursting flame. Gradually the sea calmed down and the roar of wind and waves decreased.

"Then shrieks and groans reached our ears, and we could see hundreds of terror-stricken persons flocking down to the water's edge, waving their arms and screaming frantically for help. Many of them plunged into the sea and swam out toward our ship. We took on board as many as could be accommodated."

At the time of the earthquake the torpedo boat Sappho was lying in the harbor at Messina, and one of the officers told of the occurrences as follows :

"At 5.30 in the morning the sea suddenly became terribly agitated, seeming literally to pick up our boat and shake it. Other craft were similarly treated and the ships looked like bits of cork bobbing about in a tempest.

"Almost immediately a tidal wave, of huge proportions, swept across the Straits, mounting the coasts and carrying everything before it. Scores of ships were damaged, and the Hungarian mail boat *Andrassy* parted her anchors and went crashing into other vessels. Messina Bay was wiped out and the sea was soon covered with masses of wreckage, which was carried off in the arms of the receding waters."

The later stories of ships' officers also depict the terrors of the scene with startling vividness.

LITTLE CHANGE IN STRAIT.

The commander of the Russian cruiser Admiral Makaroff, after it had arrived at Naples with refugees from Messina, gave the following account of the disaster:

"Hearing at Agoata, Sicily, of the disaster, I hurried to Messina. The city was literally nothing but a heap of ruins. Every building collapsed, but in many cases the outward shells remained standing and as a result the general contour of the city was less changed than might be expected.

"This is particularly true of the sea front. In spite of what has been said, the form of the Straits of Messina show little if any change.

"The harbor is filled with refuse of every kind, and at one end lies the wreck of a sunken steamship.

"It is impossible to give even a faint idea of the desolation of the scene. Every now and then we heard the crash of falling floors and walls. This constituted the greatest danger to the rescuers. It was not safe to approach any standing masonry. Men from my vessel had many narrow escapes, and I saw several terrible accidents to the brave Italian soldiers, who were doing more than their duty.

"We lost no time in setting about the work of rescue. We established an open-air hospital on the shore, where we received and treated

1,000 men, women and children. We also saved the safe of the Bank of Sicily with its treasure, weighing two tons.

"The mind shrinks from contemplation of the present condition in the stricken city; that there are thousands of persons still alive in the ruins, and that countless numbers must die.

"The tidal wave lasted much longer than the earthquake. During all the time we were in the harbor of Messina our vessel shivered intermittently, as though shaken by some huge marine monster.

"I could relate pathetic stories without number. Under some wreckage, inclosed in a kind of little cubby-hole and protected by two heavy beams, I discovered two little babies, safe and uninjured. They were comfortable as possible, and laughing and playing with the buttons on their clothes. We could find no trace of their parents, who undoubtedly lost their lives. It made a terrible impression to see the bereaved children.

NO JOY IN HEARTS OF SURVIVORS.

"Many little ones live while their parents are dead, and we saw many mothers with dead babies in their arms. It was also indescribably painful to see the many who had gone crazy from grief. They searched and searched aimlessly for their loved ones, keeping up the quest even after they had been brought on board our ship."

The Serapin also brought to the outer world stories of heartrending separation of families and the hopeless and frantic seeking of relatives one for the other. Just as the steamship was leaving Messina a man made his way to the dock and called again and again for his wife and children. The people on board listened attentively. Then from the vessel came an answer: "I am here, I am here," in a woman's voice. "Are the children there?" came from the dock. "Yes, we are all here," the woman replied. But there was no note of joy from the unfortunate mother. Her heart could hold no happiness after the experiences of the night.

Shortly after the Serapin docked at Naples a gangplank was lowered and a few persons were allowed to board. The refugees were found sitting in isolated groups. They gave evidence of great mental depres-

sion and were utterly exhausted. They seemed scarcely conscious of their surroundings. Most of them were held in the thrall of their terrible experiences.

A druggist named Pulco relates that at 25 minutes past 5 o'clock Monday morning he was on a ferryboat in the port of Messina, going to Reggio. Suddenly a gale of wind arose, bringing a heavy sea with it. Then a great chasm seemed to open in the water and the boat went down and struck the bottom. But the waters closed in again and the ferryboat floated safely on top of the succeeding wave. Most of the people on board, however, were swept off and drowned. The boat was badly wrecked, but it floated ashore. Pulco was still on board.

After the first panic, he landed and found Reggio like a city of the dead. Nobody was moving in the streets and the silence was broken only by the moans and groans and shrieks of the wounded. Pulco and several companions tried to extricate some wounded from the wreckage, but this was almost impossible because of the crumbling ruins. In one of the squares Pulco found a group of people all completely naked.

CHAPTER III.

FROM THE LIPS OF SURVIVORS.—HIS BED BESIDE AN ABYSS.—FACING ALMOST CERTAIN DEATH.—WOMAN SAWED FREE.—CUT FINGERS FROM DEAD.—BURIED 30 FEET DEEP.

C CONSTANTINE DORESA, a London ship broker, had a wonderful escape from the Trinacria Hotel. He tells a thrilling story of the earthquake disaster. He says:

"It was a dark, still night, the coldest I ever felt in Sicily. I went to bed late, after putting extra covering on the bed. I was awakened without warning at 5.25 o'clock. The bed first rose up and then rocked violently. I clutched the sides of the bed, which seemed to be falling through space of ages.

"Afterwards I estimated the time to be ten seconds. Then came a series of awful crashes, the roof falling all round me. I was smothered in brick and plaster. I knew it was an earthquake. I had been in one before in Athens. Then followed terrific crashes, mingled with a continuous roar.

"I felt for matches, struck a light and was horrified to find my bed on the side of an abyss."

Doresa discovered Craiger, an English friend, and from the ruins rescued a Swede and his wife. Amid the appalling surroundings they succeeded in reaching the quay and getting aboard the Cardiff steamer Afonwen. Doresa then organized a rescue party composed of the Afonwen's master, Captain Owen, three of his sailors and several Russian sailors. With Doresa and Craiger all returned to the Hotel Trinacria with ladders and ropes.

En route on the balcony of a ruined building two little children were crying for help. The building seemed ready to collapse at any moment. Second Mate Read, of the Afonwen, did not hesitate. The children were directed to lower a string with a stone tied to it. They understood, and pretty soon a piece of stone was coming down.

Meantime Read placed a ladder against a lower balcony. Then he

turned to one of his seamen, who was standing by, and said: "Now then, Smith." Doresa adds:

"I shuddered. It seemed like certain death. Smith turned his quid in his mouth, and without a word went up the ladder to the first balcony. Then, to the string which had been let down by the children, he attached a light line, which the children hauled up and placed around one of the standards at the top of the balcony.

REACHED BALCONY BY ROPE.

"By this means Smith hauled up a 2½-inch manila rope. He then took off his boots and in a trice was shinning up the rope beside the crazy ruin. I held my breath. I have read of many brave deeds, but I never heard of one braver than Smith's. When he reached the top of the balcony he leaned over and shouted: 'Why, there's a ton of them up here. I can't manage all of them myself.'

"Captain Owen turned to Read. It was enough. In a second Read was shinning up the rope hand over hand. We watched him with fear clutching our hearts.

"There was a sigh of relief when we saw him standing beside Smith at the top of the building, which seemed to be rocking to its fall every second. The men aloft soon got to work.

"One of Captain Owen's apprentices rendered great assistance. I stood at the foot of the ladder to prevent its slipping. The moments were flying. We did not know how soon the whole thing would collapse."

"An Italian workman stood staring at us. I begged him to lend a hand, but his face only assumed a more vacant expression, if that were possible, and we were left to do the work ourselves.

"Read and Smith made their hawsers fast. Then, one by one, they lowered the cowering creatures who had been awaiting death. From that crazy height the rope was lowered ten times, each time with a child resting in a slip noose the sailors had formed.

"Then came an old woman, who was very stout. We had a great deal of trouble to get her down, but managed it at last. There was one

man among the crowd of survivors. Smith threatened to throw him off the building unless he helped to lower the woman.

"At last the brave rescuers came down on the rope themselves. They had saved twelve people from certain death. They worked as coolly as if they had been on the ground. They had been in imminent danger of their lives, yet when they came down they quite resented our congratulations.

WOMAN SAWED FREE.

"There was other work for us nearby. We heard cries from a woman buried to the waist in the ruins of a shop. The buildings round her were blazing. Slowly but surely the cruel flames were creeping nearer to her. Could she be saved? Captain Owen's sharp command sent Read rushing to the Blake, a ship moored at the quay. In a few minutes he was back with a saw. He dashed through the flames and began with frantic energy to saw through the plank that held the woman fast. We waited in terrible suspense.

"Then, with relief, we saw the end of the plank fall away and Read came through the flames bearing the rescued woman in his arms.

"Just then an officer came up and asked to what ship these men belonged, and said he would send an account of their splendid bravery to his government, and hoped they would recognize it.

"'Meantime,' he added, 'I can only thank the men for their heroic efforts.' At this moment we heard cries from back of the Hotel Trinacria, which had been left standing. We saw Signor Cogi on a narrow ledge and rescued him.

"After rescuing others the party returned to the Afonwen, loaded a boat with food and returned to the shore to distribute it. Captain Owen left me in charge of the boat while he carried out the distribution. While I was guarding it five Italian soldiers came up and tried to seize it in order to escape to the mainland. I knew it was our only hope, so I threatened to shoot the first man who touched it. They made off.

"There were from twenty to thirty shocks during the day. Prowling among the ruins were panic-stricken fugitives and escaped prisoners, the latter looting. I saw wretches hacking off the fingers of the dead to get

their rings. Nothing came amiss for them. In one case they raided a woman's shoeshop and marched out with all the latest Paris and London creations.

"We were cut off from the world. All the wires were down. We could not see the lights of Reggio, which told of destruction. All things seemed to be returning to savagery. Early Tuesday morning we saw some silent gray monsters tearing up the Straits, and we could soon distinguish the white ensign. The British fleet had come.

"It brought the first help from the outside world. It brought surgeons, medical appliances, food and clothing. As soon as the sailors landed they began to restore order. It was soon found that stern measures were necessary.

SCANT JUSTICE FOR LOOTERS.

"Rifles were brought and the looters were treated with scant ceremony. Martial law had been proclaimed, and the thieves were shot at sight. The presence of these bodies of disciplined men had a remarkable and immediate effect.

"I must not forget to say a word about the Russians. Some Russian warships arrived in the afternoon of Tuesday. They immediately got to work. It was curious to notice the difference between them and our British forces.

"They didn't have our machine-like discipline or our peculiar handiness which enables our sailors to do everything that comes along, but they showed wonderful kindness and sympathy. I watched the big Russian sailors gently handling little children and soothing their fears with simple words, which, although in a foreign tongue, seemed to calm the little ones. They were just as gentle with the wounded, handling them with almost womanly tenderness.

"As Tuesday wore on, things began to assume an altered aspect. The wounded, wherever it was possible, were taken by the ships to Palermo and Naples. The dead were buried where it was possible. It will be days before many of the corpses can be reached. My local agent, for instance, who had money on him, is buried thirty feet deep under the ruins of his offices.

"Tuesday afternoon we left on the Afonwen for Naples. It has been said that navigation of the Strait of Messina has been rendered unsafe. I should like to correct that statement. I saw several vessels go through Monday night.

"There is no doubt vast changes have been brought about in the bed of the strait. The Afonwen was lying at anchor in forty-five fathoms of water. When she weighed anchor Captain Owen found there were only thirty fathoms. As to the residents of Messina, I cannot say they did much to help. They seemed to be completely panic-stricken, but their need is great and their distress appalling. Having escaped death myself I can speak feelingly for the helpless residents of Messina."

LIKE THE BURSTING OF BOMBS.

A young doctor named Rossi gave a vivid account of his experiences. His escape was miraculous, and by his calmness and energy he was able to rescue others from imminent death. The doctor was preparing to leave Messina by an early train Monday morning, the day of the disaster.

"Suddenly the profound silence was broken by an extraordinary noise like the bursting of a thousand bombs," he says. "This was followed by a rushing and torrential rain. Then I heard a sinister whistling sound that I can liken to a thousand red hot irons hissing in water. Suddenly there came violent rhythmic movements of the earth, and the crashing down of nearby walls made me realize the awful fact of the earthquake. Falling glass, bursting roofs and a thick cloud of dust added to the horror of the situation, while the extraordinary double movement, rising and falling at the same time, crumbled walls and imperiled my life.

"I rushed into the room where were my mother and sister and with a rope which, fortunately, I had with me, I succeeded in rescuing them. I was also successful in getting out of the house a number of other persons who had given themselves up for lost. Then some soldiers came and helped me, and together we dragged forth several women and children from the tottering walls of a half-destroyed palace nearby. A few seconds later this building was entirely demolished.

"There were scenes of indescribable horror in the streets and squares through which my party made its way."

Another survivor says:

"I was thrown out of bed. Then the floor of my room collapsed and I fell into the apartment under me. Here I found a distracted woman searching for her sister and son, whom she found dead. We remained in the ruins for twenty-four hours, alone, without food or drink. We made a rough shelter of boards to keep off the rain.

"Our ears were assailed with the cries and moans of the wounded. These sounds abated somewhat during Monday night. Still no one came to our assistance. We were as in a tomb, with the bodies of our children beside us. We could see no one, but every time sounds were heard from the street there would come an outburst of piercing cries for help from the injured pinioned in the wreckage.

"Tuesday morning we ventured forth and were taken aboard a vessel in the harbor, on which we went to Naples. Messina was entirely destroyed. We passed over streets that were vast crevasses and climbed over great mounds of ruins and wreckage that were all that remained of the finest palaces of Messina."

He arrived in Rome half covered with burns. His wife was clothed in little else than counterpane.

HOTEL WHIRLS AROUND.

Among others whose tragic tales wrung the hearts of his listeners was Edward Ellis, an English visitor at Messina.

His story, as he himself tells it, is as follows:

"I was on the second floor of the Hotel Trinacria," he said. "When the earthquake came I was in bed asleep. It shot me out on the floor and then turned the floor over on top of me. I managed to crawl out from under, with practically nothing on, and made a frantic rush for the door, but found it impossible to open.

"I gave myself up for lost. Both floor and ceiling went crashing down and I was left hanging to the door. The room seemed whirling round and round, and great gaps opened in the walls. A moment later everything collapsed and the whole structure fell. I landed on a heap of

mattresses, clothing and furniture and though much bruised was not disabled.

"Right in front of me in the black darkness I heard moaning. I put out my hand and touched something horrible. When I drew it back my hand was colored crimson. Some one was dying there, but I was unable to afford any help.

"Gradually I worked my way out from the debris of the fallen hotel and finally was able to rise to my feet. I began to walk over ruins, but the earth was still heaving, and several times I fell. The thick dust was almost suffocating. All around rose cries for help. Two men rushed past me so frantically that I was again thrown down, but I got up and struggled on.

WALKS OVER BODIES.

"I felt that constantly I was treading on bodies, and perhaps on living persons. Once the body of a woman fell down on me from somewhere overhead.

"I suppose I had walked two hours when, suddenly, I went waist-deep into water. A man helped me out and pointed the direction of Marina. But my troubles were not over. The wild figure of a man plastered with mud rose up before me and barred my passage. He was clearly mad, and only after a desperate struggle did I get away from him.

"Next I found myself in a street where every house was on fire, and I saw no way out until a building fell down and smothered the fire sufficiently in one place to afford me a path over the rubbish.

"Even then an enormous heap of wreckage lay in my way, which for some time I vainly tried to surmount. In my endeavors I fell into a deep hole, but in it I found some pieces of furniture and half broken steps, which helped me at last to climb to the top of the heap.

"Weakened and exhausted, I slipped and began rolling helplessly down the hillside, and was unable to stop until I was splashing into the sea. This was the end of my troubles, for I was picked up and taken aboard the steamer."

CHAPTER IV.

GROUND SPLIT UP EVERYWHERE.—RESCUED HIS RELATIVES.—OLD MAN'S CHARITY.—BOAT IN QUEER PRANKS.—IMPRISONED FOR FOUR DAYS.—ACTRESS SAVES SOLDIER.—LONG CRY OF ANGUISH.

ACHILLE CARRARA, agent of the General Steam Navigation Company in Messina, gives the following account of his experiences, which throws some new light on the circumstances of the disaster:

"Frantic with terror I shouted for my wife, my children and my servants, and assembled them under the arch of the window. The house rocked, but it remained erect. We dressed in darkness and blinding dust, while everything heaved about us. We staggered down the reeling staircase to the street.

"The street was choked with the ruins of the surrounding buildings, and masonry was falling. The injured were shrieking from their tombs beneath the wreckage, and the ground was split up everywhere. Horror was piled on horror, and inky blackness pressed upon us with here and there a flame shooting out from among the wreckage.

"At daylight we found our way to the harbor, where the tidal wave had thrown the water 14 feet above the quay and broken every vessel adrift. The harbor was full of wreckage, casks and capsized skiffs. Four steamers, which had been flung on the quay, had been refloated as the great wave receded, and were hanging by their anchors. They were the Elro, Drake, Varez and another. We hailed the Drake, and were taken aboard and well attended to.

"Later the captain of the Drake sent a party with me to rescue my relatives, who lived in the north end of Messina.

"The British consulate was found to be a mere dust heap. I located what had been my brother's house, and after digging for hours with our hands succeeded in breaking our way through the fallen masonry, rafters and broken furniture. We rescued my brother, his wife and child and 18 other persons. We found no trace of my father, mother, grand-

mother, sister or aunt, and all must have been crushed under the ruins of the three houses."

Carrara adds that "during Monday night two fresh and terrible shocks razed to the ground what was left of the town."

One old man on the streets of Naples was carrying a little girl in his arms. The child was covered with blood. "Is that your child?" he was asked. "No," he replied. "Yesterday I found her on the pavement in Messina. I picked her up and cared for her. No one claimed her and I couldn't abandon her. I have had her in my arms ever since." With this touching explanation the old man became oblivious to his questioner and everything around him.

The Serapin took to Naples records of numberless tragedies. Families separated, mothers moaning and crying for their dead children, husbands and wives lost to each other, or a sole survivor wishing that he had not been spared. There was one girl on board the steamship, her clothing tattered and torn, who had saved a canary bird. She was a music hall singer and had clung to her pet throughout the terrible scenes of devastation. The bird was the only happy thing on board the vessel.

The stories told by these unfortunate refugees are almost unbelievable.

IMPRISONED FOR FOUR DAYS.

A soldier named Emilio de Castro relates that on Sunday, the day before the disaster, he was taken sick and was sent to the military hospital. Early Monday morning he was awakened by a tremendous roaring sound. He felt himself falling and thought he was in the grip of a nightmare. It seemed to him that he had awakened in hell, for the air was filled with terrifying shrieks. He soon realized, however, what was happening. His bed struck the floor below and he was still on it. It paused a moment and was again precipitated. He struck the next floor, but this gave way at once, and thus man and bed came down from the fifth floor of the hospital to the ground. The soldier was not injured.

After being imprisoned four days Deputy Nicolo Fulci's wife was extricated from the ruins, and it is hoped she may survive. Her young

niece also was brought out alive, but died soon afterward. Men searched long for the Deputy, whose voice was heard up to Wednesday night calling for aid.

An infant clothed in a little night shirt was rescued well and uninjured after having laid four days on a square yard of flooring in a house that was otherwise entirely demolished.

The Archbishop of Messina was found alive in the ruins of his palace.

The Marquis de Semmola was buried in the cellar of his residence, but found a larder and kept himself alive until he was rescued.

The Mother Superior of St. Vincent Military Hospital, at the risk of her own life, alone and unaided, saved Colonel Minicci and his daughter from the ruins of their home.

Flora Parini, an actress, lying half buried in wreckage, heard the voice of a lieutenant of artillery close at hand, who had recognized her, crying:

"Signorina, save me! Call some one to rescue us. Don't leave me. I was at the theatre last night, and I applauded your singing. I have a mother; don't leave me to die."

ACTRESS SAVES SOLDIER.

The woman was eventually dug out, led her rescuers to where the soldier was pinned down, and he, too, was saved.

The sufferings of persons buried in the ruins was awful to contemplate. Dead bodies have been found which bear mute testimony to the torture endured before death. Several died gnawing their arms and hands, evidently delirious from pain and hunger. Other bodies had parts of shawls and clothing in the mouths. One woman's teeth were firmly fixed in the leg of a dead babe.

Signor Vidala, the proprietor of a local newspaper, relates that he was superintending the printing of an edition when the shock came. He managed to get out to the street before the building collapsed, and groped his way to the Place Cavour, which had been transformed into a huge crevasse.

For the first ten minutes after the initial shock one long cry of

anguish seemed to rise from the city, then there was comparative silence for a short while.

The worst shocks were over by 6 o'clock.

Vidala made his way to his home, and found his family under the ruins. As he was telling his tale a wild-looking individual, in strange clothing, came up to the correspondent and the newspaper proprietor.

"I also am bereft of all my family," he interrupted. "I now am alone in the world like you, Vidala." It was evident that this man was half crazy. He had saved a daughter from the ruins, but his two sisters had been killed. Later he died of his injuries.

Signor Serao, owner of the house in Messina where English Consul Ogston resided, escaped. The part of the house where Serao lived did not fall. He rushed out after the first shock, and met Stuart K. Lupton, the American Vice-Consul, in the street. Signor Serao says:

"It is impossible for the wildest imagination to picture anything more terrific than the destruction of Messina. Climbing over broken beams, shattered walls and broken furniture, we finally reached the spot where the American Consulate had stood.

"The Consular building was about three stories high. It had entirely collapsed. We could hardly believe our eyes. Mr. Lupton climbed over the ruins calling out 'Cheney! Cheney!' Confident that the Consul would answer him, he said to me:

"'Daylight has not come yet and that is why I cannot see him, but he must be somewhere in the wreckage.'

FRANTIC SEARCH FOR THE CHENEYS.

"Our search became more and more feverish, but as time wore on and it was still unsuccessful we finally realized its hopelessness. We saw it would be impossible to reach even the bodies of the unfortunate Cheneys. In addition to the collapse of the Consulate a neighboring building had been precipitated upon the Consular ruins and the whole was a vast mass of wreckage.

"Touched by Mr. Lupton's despair I tried to console him, saying that undoubtedly the Cheneys had been vouchsafed the mercy to die

immediately and not linger alive under the debris. We then left the ruins of Mr. Cheney's home, having done everything in our power.

"With Mr. Lupton I went on board the Standard Oil steamer Chesapeake, where we remained for the rest of Monday. We transferred afterward to the British ship Minorca.

"Mr. Lupton was most anxious to communicate with the department at Washington and managed to get a wireless message through Malta.

"Later Mr. Lupton and I, together with a party of British sailors, went ashore again. Mr. Lupton was most anxious to learn if there had been any American victims of the earthquake. I was able to reassure him as, having lived in Messina forty years in constant touch with the American Consulate I never knew of a single American resident.

"To make assurance doubly sure we questioned everybody we met who would be at all likely to know of any Americans, especially the managers and the waiters of the Hotel Trinacria."

MAIN STREET DESTROYED.

A woman gave the following account of her experience:

"As soon as I could get out of my house I ran in the direction of the water front. I noticed that the greater portion of the main thoroughfare of the city, the Via Garibaldi, was destroyed. A thick dust prevented me from seeing more than three feet in any direction. From every side I heard the cries of the wounded and the shrieks of terrified women. I struggled through water and mud up to my knees, and succeeded in gaining one of the docks. From there I was taken on board a cruiser in the harbor.

"While on my way down to the water, groping through the dust and darkness, a band of about 100 persons rushed upon me like maniacs. They were fleeing up-town. They separated me from my companion, whom I never saw again."

Two doctors who succeeded in escaping declared that entire streets caved in. One of the doctors was sleeping in a room on the third floor when the first shock came, and saved himself by gripping the roof of a neighboring house.

A ferryboat moored at one of the docks seemed suddenly to be thrown high into the air. It landed on top of the dock, and was left hanging there by the receding waters. This was the first intimation of the crew that anything had happened.

The captain of the boat says a huge cloud of dust obscured the city. With dawn came an overwhelming picture of devastation. The captain and his men landed and tried to make their way into the city, but the fallen buildings and the twisted streets made progress impossible.

\$2,000,000 IN TREASURE SAVED.

The entire local treasury of the Messina branch of the Bank of Italy, some \$2,000,000, was saved and taken on board an Italian warship.

The rescuers at Messina were rapidly exhausted. The fires raged long, and there was no water with which to combat the flames. Many of the people refused to leave the ruins of their houses. They clung to the sites of their homes, crying out that their only safety was in fidelity to the wrecks of their houses. Force often was necessary to get them to the ships in the harbor.

A dispatch from Deputy Felice at Messina said:

"Organize a squadron of volunteers for rescue work. Send us food, for we are dying of hunger. A number of the survivors are leaving to-day for Catania. Receive them with love and fraternity. It is the duty of every family in Catania to shelter a family from Messina."

Only two members of the municipal Council of Messina survived the disaster.

The bluejackets from the Russian warships at Messina performed valorous service. They risked their lives recklessly in the work of extricating the wounded.

A roll-call of the Eighty-ninth Regiment of Infantry reveals that the organization has only ten survivors. A man named Roberto, the sole survivor of his family, became mad from grief in Catania and committed suicide.

Lily Wolffsohn, an Englishwoman, collected some graphic stories from the survivors. One man, employed by a German cotton firm in Messina, said:



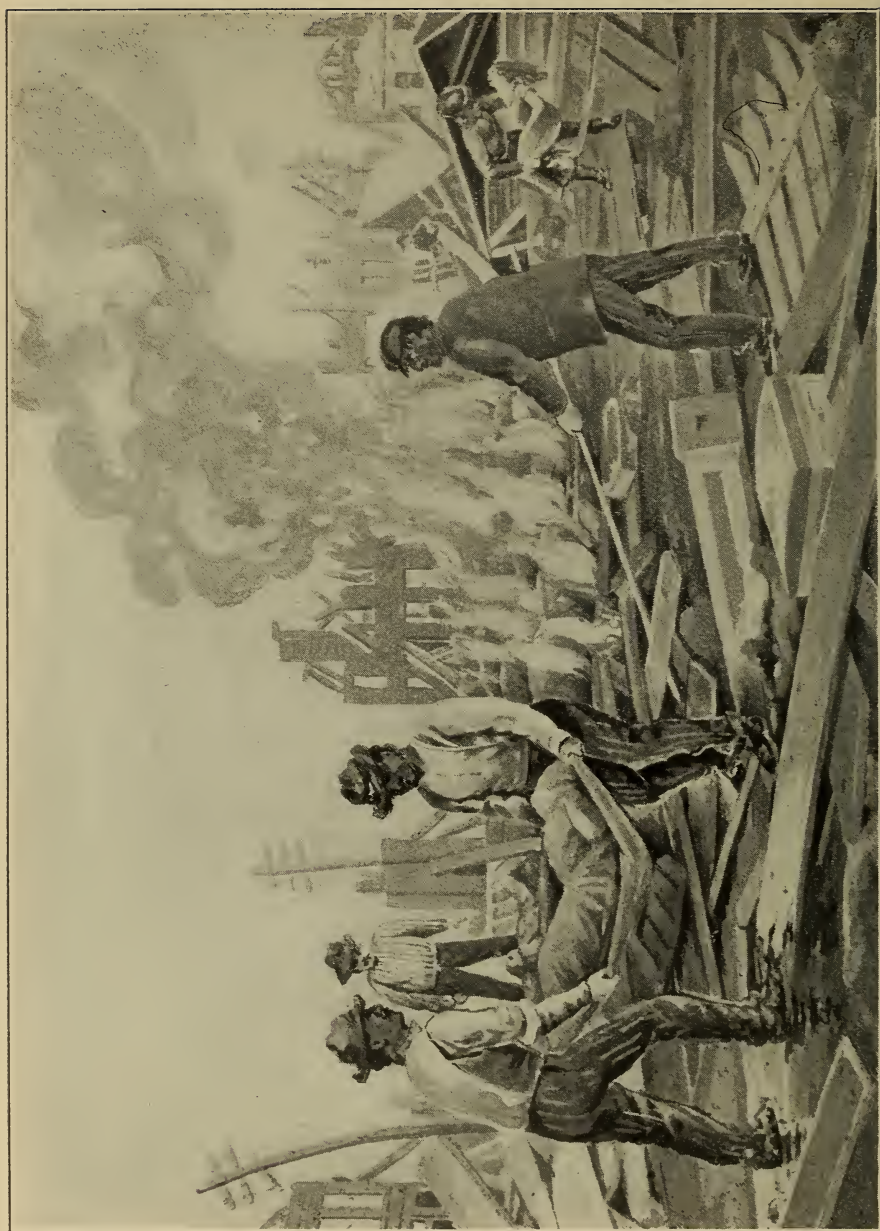
MORNING OF THE EARTHQUAKE—VIVID SCENES OF TERROR IN MESSINA
WHILE SOME ESCAPED, THOUSANDS WERE BURIED UNDER THE RUINS



PART OF THE RUINS OF REGGIO, FROM WHICH BUT FEW ESCAPED ALIVE



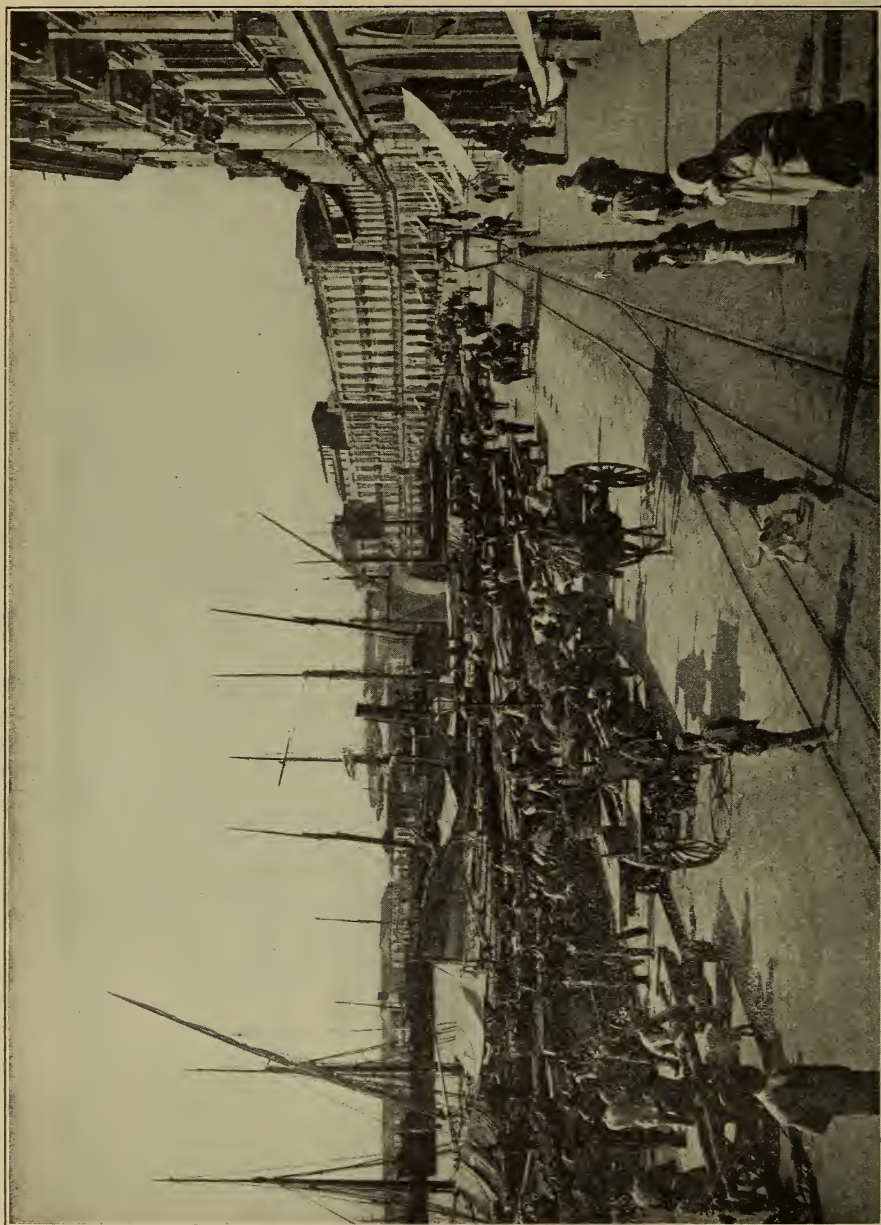
SHOOTING VANDALS ENGAGED IN ROBBING THE BODIES OF THE VICTIMS



CREMATING BODIES EXCAVATED FROM THE RUINS



RUINS OF THE OLD GREEK THEATRE AT TAORMINA NEAR MESSINA



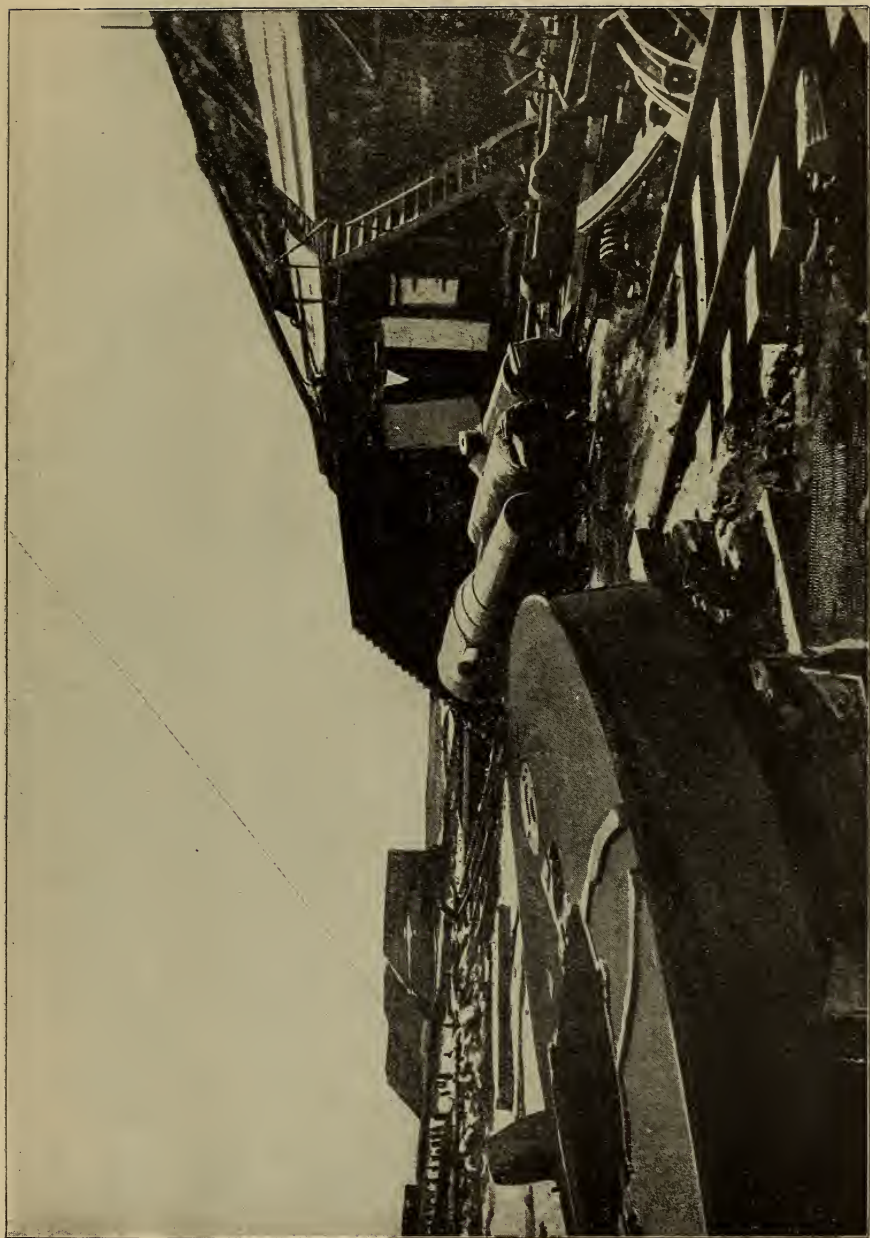
SCENE IN MESSINA, SHOWING HARBOR, WHARVES AND SHIPPING



SCENE SHOWING THE TERRIBLE DESTRUCTION WROUGHT BY THE EARTHQUAKE AND TIDAL WAVE AT BAGNARA IN CALABRIA



CHURCH OF SAN GREGORIO, MESSINA, DESTROYED
BY THE EARTHQUAKE



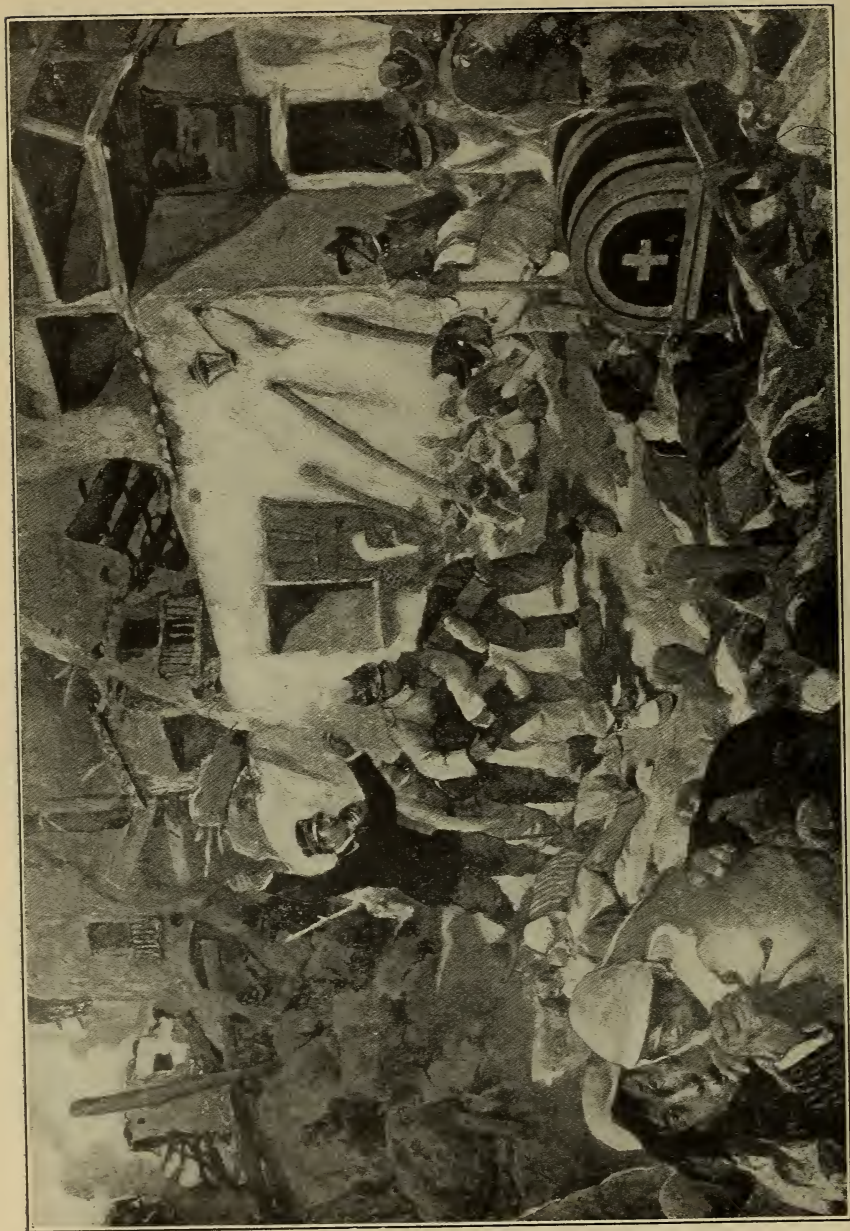
FORT NEAR MESSINA, WRECKED BY THE EARTHQUAKE



SCENE OF HORROR WHERE WHOLE FAMILIES WERE OVERWHELMED BY
EARTHQUAKE AND FIRE



FLEEING FROM DEATH AND DESTRUCTION BY
LAND AND WATER
SHOWING PANIC STRICKEN PEOPLE IN MAD FLIGHT FROM
EARTHQUAKE AND TIDAL WAVE

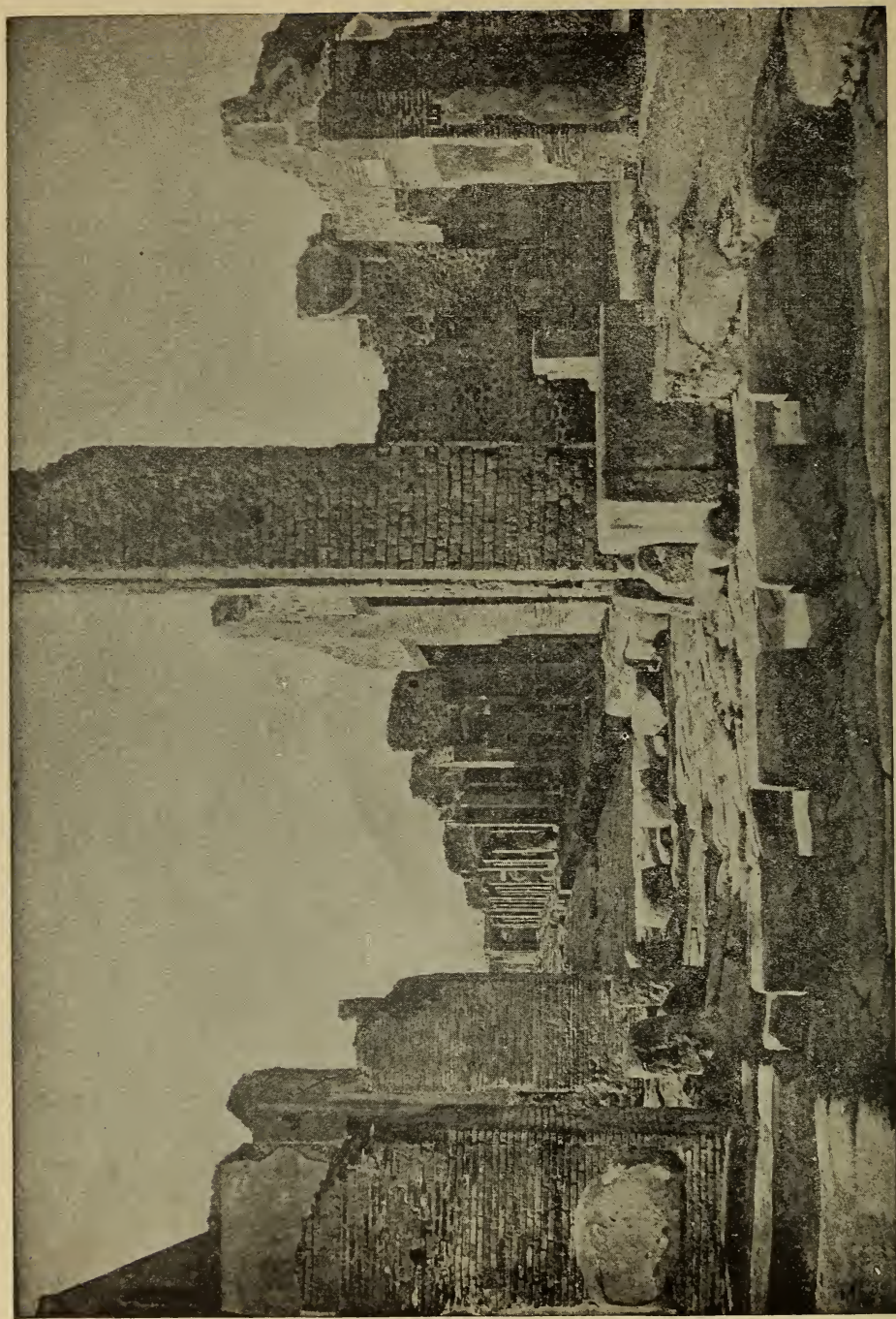


RESCUING VICTIMS OF THE GREATEST DISASTER FOR CENTURIES
SCENE AFTER THE TERRIBLE EARTHQUAKE IN MESSINA

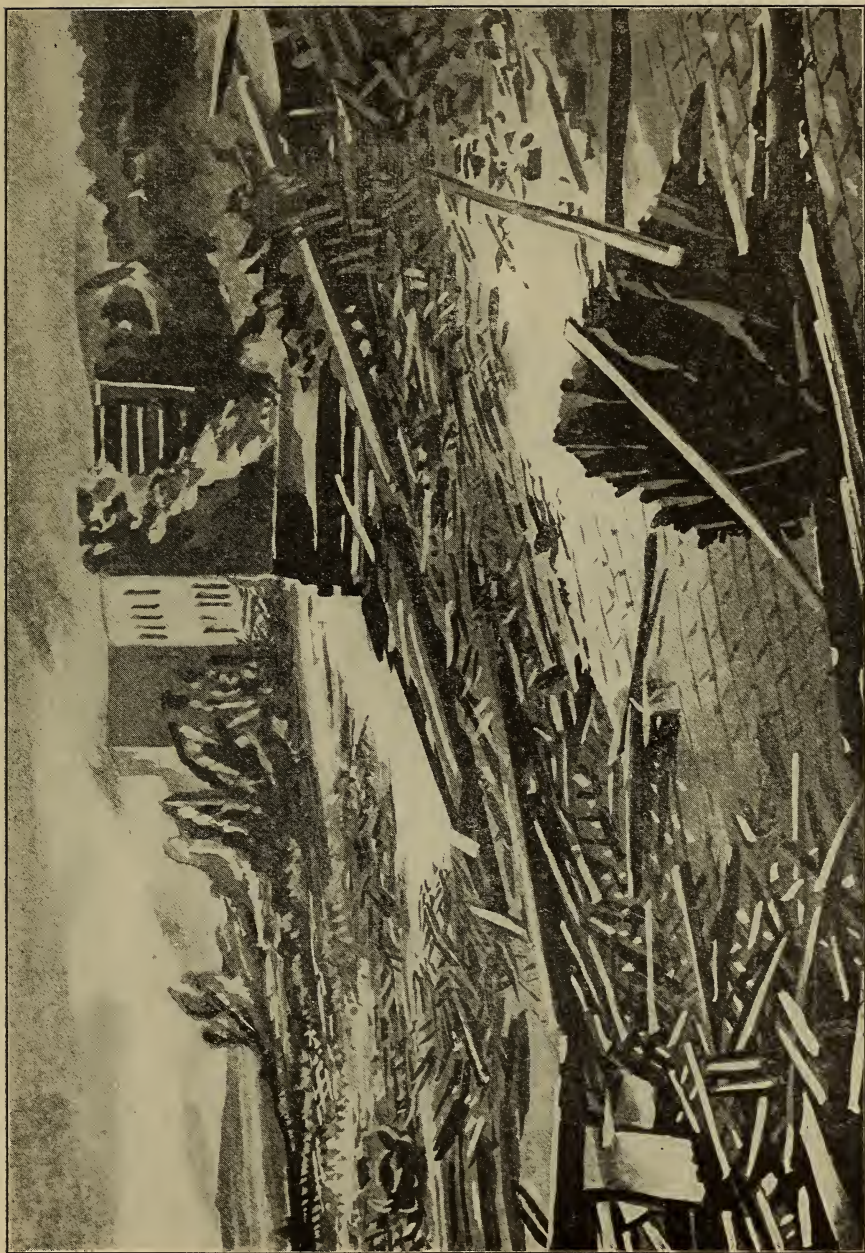


**ARRIVAL AT CATANIA OF EARTHQUAKE REFUGEES
FROM MESSINA**

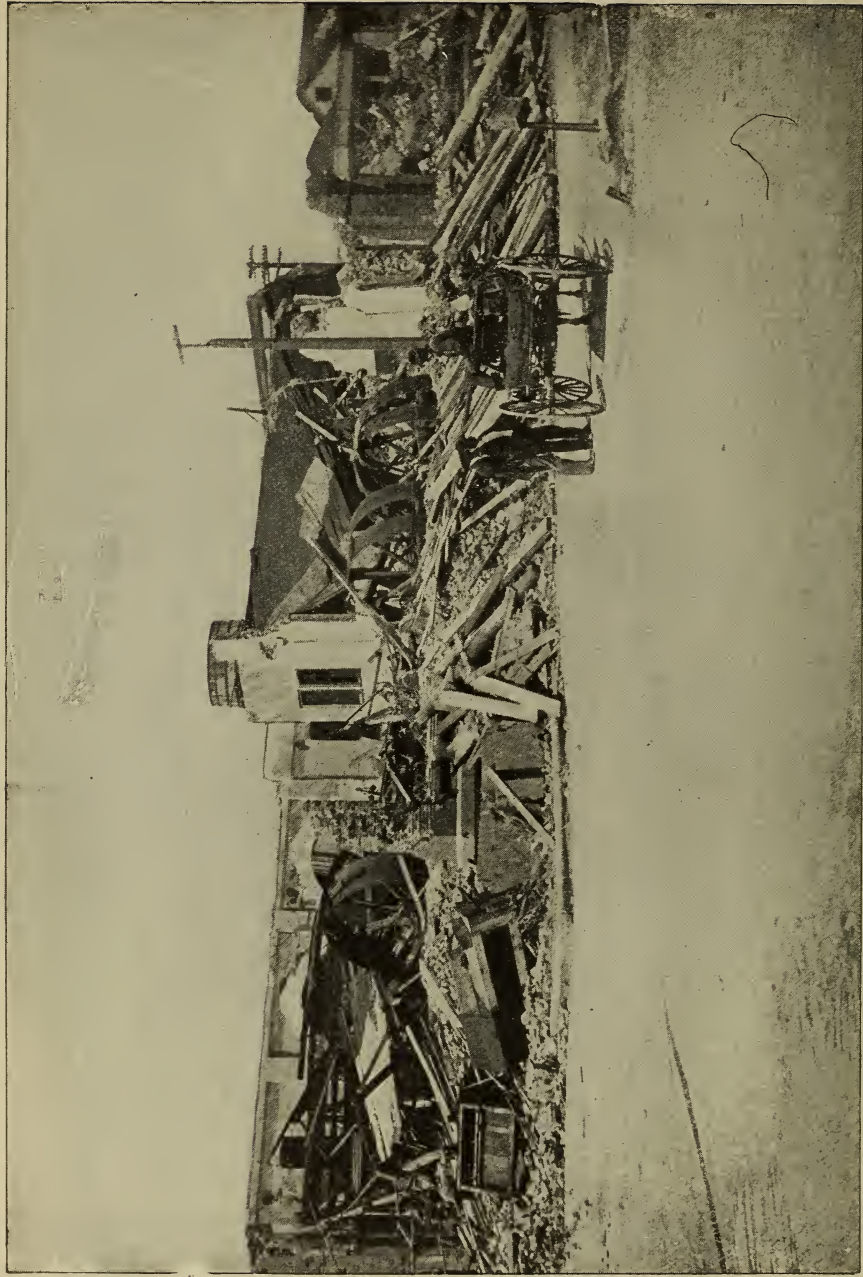
**PRIESTS COMFORTING THE STRICKEN SURVIVORS, WHO ARE
HEARTBROKEN BY THEIR TERRIBLE EXPERIENCES**



SCENE IN POMPEII—SHOWING EXCAVATED STREET



SCENE ALONG THE WATERFRONT OF MESSINA.



RUINS OF BAGNARA—SHOWING AWFUL HAVOC WROUGHT BY EARTHQUAKE

"Messina is utterly destroyed. Nothing remained when I left but part of the citadel. A few soldiers were the bare survivors of the whole garrison, and here and there a horse is seen asleep standing erect.

"When the first shock awoke me, I lit my lamp, but all was quiet, and I turned to sleep again. Suddenly, fresh shocks occurred in violent and terrific repetition. I rose, but the house was swaying and my door jammed. I tore sheets from the bed and made a rope and lowered myself from the window to the street. An Italian family of five persons escaped from the house with the aid of my rope.

ATTEMPTS AT RESCUE USELESS.

"No sooner were we in the street than the house collapsed. I tried to help in the work of rescue, but it was useless. All day I wandered in the wrecked streets. No food could be got, and I had only a few nuts to eat.

"The head of my firm, who lost his brother, had to go through the streets begging for bread for his wife and children. There was no organization in the work of rescue. The Messina prison was destroyed and the warders killed, but most of the convicts escaped, and they prowled among the ruins, robbing and murdering. They cut off the fingers of the dead and wounded to take the rings, some of them singing songs as they plied the knife.

"A Russian vessel lying in the harbor was thrown into the street by the tidal wave and other vessels foundered. The railway lines sank into the ground. The square known as Campo Santo collapsed and sank and only the summits of a few ruined buildings still emerge from the wreck. The fugitive population when I left was camping near the harbor."

CHAPTER V.

EYE-WITNESSES TELL OF HORRORS.—SLEEPING WHEN CRASH CAME.—
SOLDIER'S MIRACULOUS ESCAPE.—PUBLIC BUILDINGS GONE.—
LOOTERS SHOT DEAD.

MME. KARALECH, a Hungarian prima donna, who was in Messina at the time of the earthquake, gives this account of her thrilling escape from a horrible fate:

"I had appeared at the opera the night before in 'Aida,' and had returned to Hotel Trinacria, retiring to rest at 2.30, but could not sleep. As I was lying awake I suddenly felt the hotel rock and collapse.

"I leaped from a window, breaking both arms in the fall. Despite the pain, which I scarcely felt, I picked myself up and started running toward the shore.

"I was joined by a number of other frightened refugees, all staggering blindly on, uttering cries and lamentations.

"Ultimately we arrived at the beach, when we were taken on board the Italian cruiser Piemonte and conveyed to Palermo."

A woman who escaped unhurt told of her experience:

"We were all sleeping in my house when we were awakened by an awful trembling which threw us out of our beds. I cried out that it was an earthquake, and called to the others to save themselves, while I quickly pushed a few clothes into a valise. The shocks continued, seeming to grow stronger. The walls cracked and my bureau split in two and then crashed to the floor, nearly crushing me. My hands trembled so that I could scarcely open the doors.

"To increase the terror a rainstorm, accompanied by hail, swept through the broken windows. Finally, with my brother and sister, I succeeded in gaining the street, but soon lost them in the mad race of terror-stricken people, who surged onward, uttering cries of pain and distress. During this terrible flight balconies, chimneys and tiles showered down upon us continuously. Death ambushed us at every step. Instinctively I rushed toward the water front, transformed into a muddy,

miry lake, in which I slipped and often fell. I only learned afterward that I was rescued, senseless, by a soldier and carried to a train."

The following graphic story is told by a woman who escaped, badly injured:

"'Infernal' is the only word that will absolutely describe the fearful and terrifying scene," she said.

"When the first shock came most of the city was fast asleep. I was awakened by the rocking of the house. Windows swayed and rattled and crockery and glass crashed to the floor. The next moment I was violently thrown out of my bed to the floor. I was half stunned, but knew that the only thing to do was to make my way out of doors. The streets were filled. Everybody had rushed out in their night clothes, heedless of the rain falling in torrents. Terrific shrieks arose from all sides and we heard heartrending appeals for help from the unfortunates pinned beneath the ruins.

GAS WORKS BLOW UP.

"Walls were tottering all around us, and not one of my party expected to escape alive. My brothers and sisters were with me, and in a frenzy of terror we groped our way through the streets, holding our own against the panic-stricken people and clambering over piles of ruins, until we finally reached a place of comparative safety. But this was not done before I was struck down and badly injured by a piece of furniture that fell out of the upper story of a house.

"All along the road we were jostled by scores of fleeing people, half clad like ourselves. The houses seemed to be crashing to the ground in whatever direction we turned.

"Suddenly the sea began to pour into the town. It seemed to me that this must mean the end of everything. The oncoming waters rolled in in a huge wave, accompanied by a terrifying roar.

"The sky was aglow with the reflection of burning palaces and other buildings, and as if this was not enough there suddenly shot up into the sky a huge burst of flame, followed by a crash that seemed to shake the whole town. This probably was the gas works blowing up.

"Eventually we reached the principal square of Messina. Here were

found two or three thousand utterly terrified people assembled. None of us knew what to do. We waited in an agony of fear. Men and women prayed, groaned and shrieked. I saw one of the big buildings fronting on the square collapse. It seemed to me that scores of persons were buried beneath the ruins. Then I lost consciousness and I remember no more."

A. J. Ogston, British Vice-Consul, escaped with his daughter, but was badly hurt.

"At the first shock," he said, "my wife rushed to a cot and snatched up the child. As we were passing a building a balcony fell and killed my wife. By a miracle the child escaped unhurt.

"I rushed to the municipal square, where 50 people had gathered, and we ran madly for the open country, balconies, columns and chimneys falling around us in a terrifying manner. The members of our party were struck down half a dozen at a time, and when we reached a place of safety only four of the party remained. The others undoubtedly were killed."

WOUNDED SOLDIER'S MIRACULOUS ESCAPE.

A wounded soldier relates this thrilling tale of his miraculous escape. Between his tears for the fate of his less fortunate companions he said:

"The spectacle was terrifying beyond words. Dante's 'Inferno' gives you but a faint idea as to what happened at Messina. The first shock came before the sun had risen. It shook the city to its very foundations. Immediately the houses began to crumble. Those of us who were not killed at once made our way over undulating floors to the street. Beams were crashing down through the rooms, and the stairs were equally unsafe.

"I found the streets blocked by fallen houses. Balconies, chimneys, bell towers, entire walls had been thrown down. From every side of me arose the screams and moanings of the wounded. The people were half mad with excitement and fear. Most of them had rushed out in their night clothes. In a little while we were all shivering under a torrential downpour of rain. Everywhere there were dead bodies, nude, disfig-

ured and mutilated. In the ruins I could see arms and legs moving helplessly. From every quarter came piteous appeals for aid.

"The portion of the town down near the water was inundated by the tidal wave. The water reached to the shoulders of the fugitives and swept them away.

"The City Hall, the Cathedral and the barracks crumbled, and churches, other public buildings and dwellings without number were literally razed to the ground. There were 200 customs agents at the barracks; only 41 of them were saved. At the railroad station only eight out of 280 employes have been accounted for.

"Many of those who succeeded in escaping with their lives are incapable of relating their experiences coherently. I questioned all who were in a condition to talk. Most of them told the same story. They said the first thing they knew they were thrown out of bed, and amid crashing ceilings and falling furniture managed to make their way to the street. Then, in the blackness of night and amid a pouring rain that added to their horror and distress, they rushed blindly away amid the crash of tumbling buildings and the shrieks and groans of those buried in the ruins. Many, while trying to escape, were struck down by falling balconies and masonry, and still many others lost their reason and are to-day wandering aimlessly in the open fields outside the city or up and down the ruined streets they knew so well.

LOOTERS ARE SHOT DEAD.

"The looters and the robbers were shot dead by the rifles of the soldiers."

But perhaps the best account of the terrible scenes in Messina and its neighboring towns following the disaster is furnished in the accounts of the Marquis di Ruvolito, the first written from Catania on the second day following the earthquake and the next on the succeeding day.

The Marquis said:

"I have just returned from Messina. The city is absolutely destroyed. The spectacle is a terrifying one, the ruins are a prey to the roaring flames.

"The great conflagration started immediately after the earthquake

and devoured all that the shocks had spared. Nearly the entire population is buried in debris.

"The calculations place the total number of survivors at only 10,000.

"Thus the dead at Messina and its environs alone will reach the stupendous figure of nearly 100,000.

"Help from the outer world is at last beginning to reach the stricken city. The British armored cruiser Sutler steamed in from Malta and was followed by the Russian battleships Slava and Tsaritsa and the armored cruiser Admiral Makaroff. The officers and men of the two navies gave every possible aid, yet their task is a fearful one.

"Under the pelting rain open-air hospitals are being installed in what were once the streets of the town. The sights on every hand are so tragic it is almost impossible to describe them adequately in terms of the human language. The utmost depths of anguish and suffering seem to have been reached and imagination stands aghast before the effect of this catastrophe.

GARRISON PERISHED.

"The garrison in Messina perished in the ruins and persons who survive unhurt cannot escape from the vast smoldering tomb in which their kinsmen, wives, husbands, parents and children lie. The sea is closed to them for want of ships and they are suffering from the cruel extremities of hunger and thirst.

"Here and there they can be seen searching eagerly for some morsels to eat or water to drink, but the heaps of dust and debris yield them nothing. At every turn some lamentable scene meets the eye, men and women half naked and terribly injured imploring relief.

"The hospital and chemists shops have disappeared and there are neither drugs nor surgical instruments. The Government officials from Catania are doing their utmost. The Catania fire brigade also arrived and is working with the Russian sailors to extinguish the fires.

"An Italian battleship reached Messina to-day and landed seamen and soldiers, while troops are on the way from Catania and Naples.

"But it will take at least a year to remove the dead from under the ruins. The catastrophe surprised the people while they were asleep, which helps explain the immensity of the loss. The prison collapsed and

many of the prisoners escaped, so that a number of desperadoes are let loose upon the ruined city.

"The custom house, railroad station and all buildings and institutions disappeared, not a single official or public functionary remaining.

"The streets are so completely gone that it is impossible to find one's way about. The offices of the Bank of Italy have been wrecked, but the safes in the strong rooms remain intact with their treasure in them.

"Some few dead have already been recovered from the ruins and buried in the public gardens. The search for the wounded and injured in the debris is being vigorously prosecuted and there is hope that even now, two days after the earthquake, further rescues may be made."

In his second letter, written on the day following, Marquis di Ruvo-lito says:

"I am sending this message by motor car to Catania, as it is still impossible to telegraph from Messina or the neighborhood.

"The estimate of the total dead in Messina, Reggio and all Calabria has risen to 300,000.

HAVOC WAS UNIVERSAL.

"The disaster exceeds all efforts of imagination and the havoc is so vast and universal I scarcely know how begin to describe it. The horror of it all is, indeed, beyond words.

"When I enter the ruined area from Catania I find myself a prey to indescribable emotions. The spectacle that greets the eye here is beyond the imagination of Jules Verne. The Corso Cavour at Messina is nothing but a huge mound of stones. In company with a deputy I endeavored to explore it. It was 5 o'clock in the evening and already dark, and rain was falling. We first saw a homeless family sitting on a heap of stones. They were half naked and huddled together under a single umbrella. We asked them to come with us and be relieved, but they refused, saying they preferred to die on the ruins of their home.

"Hard by a poor white-haired woman was shivering on the ground, covered only with a bed quilt. She begged for help, saying she had been an artist at the Pelolo Theatre. She was barefooted and practically naked and said she had eaten nothing in three days. We asked her

to come with us to the station, but she would not go save on condition we brought her a pair of shoes. This was impossible.

"We were then forced to return on account of darkness, and, tired and hungry, we arrived at the station. It was thronged with a half-mad, terrified crowd. There was no water and nothing to eat and nowhere to sit down.

TWENTY ROBBERS SHOT.

"Numbers of peasants from surrounding villages have flocked into town to rob the corpses and sack the ruins. The authorities have ordered that these ghouls, when found, be immediately shot. Twenty were thus executed yesterday, and one wretch was discovered by a Russian sailor in the act of cutting off a finger from a corpse for the sake of a ring, and was shot with a revolver. Martial law has been proclaimed.

"The survivors were awakened from their sleep by the disaster and ran unclothed into the streets. Subsequently they were compelled to cover themselves with anything they could find. The results would in other circumstances be ludicrous, some of the men being clothed in skirts and bodices and some of the women in military uniforms, while others of both sexes have nothing but blankets wrapped round them.

"Here among the ruins I encountered an acquaintance, Baron di Scotti. He was covered with mud. He wore a pair of white undergarments, an opera hat and wooden sabots. I met a survivor of an Italian family named Bonanno. He carried a dead child in his arms and appeared to have lost his reason. Several people were literally stricken dumb by the catastrophe, but their silence was counteracted by the groanings from the wounded who still linger invisible, but not inaudible, beneath the ruins.

"Help is arriving constantly from Catania and Palermo by sea to relieve the thirst and famine. The whole Calabrian shore for a distance of nearly thirty miles was torn and twisted by the convulsions of the earth and sea. Neither bridges nor ferryboats exist, all having been destroyed.

"The town of Villa San Giovanni was destroyed, and Scilla, Pizzo and Bagnara shared its fate, in each case the havoc of the earthquake being completed by the outbreak of fire.

"One fugitive declared that the hills opened and swallowed up four

towns. It would be utterly impossible to attempt to give any kind of a list of dead, survivors and injured."

Another thrilling account was furnished by a newspaper man who reached Messina after an adventurous journey on foot through the wasted Calabria region.

"I arrived at last at Messina, with my legs almost dropping off, after tramping thirty-one consecutive hours, covering a distance of forty-one miles. My nerves will never recover from the atrocious impressions to which they were subjected, and my eyes will retain as long as they remain open the vision of death and devastation which oppresses them. A mournful silence covers the country like a funeral pall.

"I proceeded as far as Palmi by train, and thence afoot. Six or seven inhabitants accompanied me to Tropea, and I decided to reach Reggio at whatever cost. Two or three railroad firemen, cut off from home while at duty by the catastrophe, were returning to seek news of the fate of their families. They preceded me, brandishing resinous, smoky torches. We marched in Indian file through the tunnel from Palmi to Bagnara, holding hands and stumbling over ballast heaps. The roof of the tunnel was cracked everywhere, and now and then rocks fell. Whole families were encamped around wood fires and smoking torches. Many of them were wounded. Men, women and children, stupefied by the catastrophe and crouching among the stones, looked at us with vacant glares, as if their thoughts were wandering.

BAGNARA'S MAYOR WAS SAVED.

"Some distance along we came upon families roasting sea birds which had been killed by the tempest and cast upon the beach. Others had the strangest objects packed in sacks. In reply to questions as to what had happened at Messina and Reggio, they made vague and desolate gestures, and continued to gaze at us like stalled oxen. After two hours' march we saw Bagnara, perched on the spur of a mountain overhanging the sea.

"The country house of the Mayor, on the summit of the rock, was half tumbled into the sea, but the Mayor was safe. He was giving orders for the installation of a telegraph wire in a freight car. Every house in

the town and surrounding country was in ruins. In one I saw tumbled beds and disordered dining rooms. Seated on the broken wall was a man selling bread at exorbitant prices, amid a chorus of curses and maledictions. Another, demented, was trying to dig into the ruins with his fingers.

"The tunnel beyond Bagnara was impracticable. An enormous portion of the mountain had fallen and obstructed the road. We were forced to walk in the sand, often up to our knees in water. Beyond the tunnel the track was torn and the rails twisted. Huge rocks and dangerous masses came rumbling down momentarily. We decided to climb the mountain and advance across the ravines of brushwood.

"Night fell; the rain was coming down in a deluge. My guides marched more with their brains than their legs. I followed mechanically, though ready to drop. At 11 o'clock we reached Pavazzina, a hamlet of 300 inhabitants. Only seven persons remained and they were shivering under the shelter of a couple of sheets stretched across two olive trees. They asked us pitifully for bread, but we ourselves had not eaten since the start, and we knew not what to answer; so we left them hopeless.

SAVED BY SOME SAILORS.

"After eleven hours we had covered only twenty miles, every stop at the cost of the greatest exertions. Our clothes were soaked and the torches had burned out. At Scylla we decided to rest, but rest was impossible. The whole countryside, except to the north, was completely blotted out. Walls were standing, but the interiors had collapsed, carrying down the sleeping occupants."

Signor Birot, the Mayor of Brescia, in Lombardy was stopping at the Hotel Trinacria, in Messina, and was buried under the ruins of the building for five hours. Finally, several persons approached the place where he lay, but at that moment a fresh shock put them to flight. Eventually, a body of sailors extricated him unconscious and took him aboard a ship.

Sunday night Signor Birot dined with a party of English, French and Germans at the hotel, all of whom perished.

The twelve-year-old son of Professor Gabi saved his father and mother, who were buried under a mass of wreckage.

A newspaper man, who left Messina for Taormina shortly before the catastrophe, turned back as soon as he learned what had happened, and approached Messina on foot. He was stopped in the outskirts by heaps of ruins. He then met people running wildly and crying for help. The nearer he got to the city the more awful were the sights. The railroad station was in flames. Everywhere he encountered half clad unfortunates fleeing through the night, under the pelting rain. He passed a cemetery and saw that the graves had burst open. Arriving at his own house, he found it completely destroyed and his wife dead under the ruins.

A custom house officer at Messina has become deaf and dumb as a result of the shock.

Sailors from the foreign warships had gathered together three hundred wounded and were caring for them in the public garden at Messina. Suddenly the improvised hospital caught on fire, and the sailors with difficulty saved two hundred of their patients, but it is feared that the others perished.

Archbishop Arrigo, of Messina, who was at first reported killed, was rescued. He says: "I was in my chapel at the moment of the catastrophe. When I endeavored to make my way out I found all the exits blocked with wreckage. I knelt before the figure of the Saviour, awaiting death, which I momentarily expected. I remained in the attitude of prayer through the rest of the night and the following day, when a rescue party reached me."

CHAPTER VI.

REGGIO VANISHES IN TIDAL WAVE.—WHEN IT FINALLY EMERGED FEW OF ITS 50,000 POPULATION SURVIVED.—NOW AN UTTER RUIN.—FACE OF COUNTRY CHANGED.—ANARCHY.

BUT Messina, while by far the greatest sufferer, was not the only city devastated. The gruesome roll of the dead elsewhere in the stricken region equalled, in the aggregate, if it did not exceed that of the city by the straits.

Messina had more property loss than any other one point. More men, women and children's lives were ground out there than in any other city.

But that was only because Messina was the most populous town in the stricken region—in that gory belt of death that stretched from the heart of the isle of Sicily northeastwards under the Straits of Messina and through the centre of Calabria, the most southerly of the provinces, or states, of the Kingdom of Italy.

In Messina, horrible as was the disaster, one person in ten escaped the holocaust.

In many of the smaller towns and villages within the range of many miles, not a human being lived to tell the tale when the sun rose on that memorable 28th day of December, 1908.

Messina's prominence in the annals of the disaster is due more largely to the fact of its great size and reputation throughout the world than to the completeness of its destruction or to the proportionate loss of life.

Next to Messina, the quaint and beautiful city of Reggio di Calabria was the greatest sufferer. This charming town, the capital of the province of Calabria, lay nestled at the water's edge on the mainland, some eight miles or so to the southeast and across the straits.

When Messina collapsed, steamships hastily put out to cross the straits for help. Half way over they met scarred and battered ships from the other coast, carrying the news that Reggio, too, had perished.

And that before the terrible tidal wave that dashed from the opposite Sicilian shores had engulfed the city and had buried beneath its foaming crest almost all of what had remained of the city's fifty thousand inhabitants.

Reggio, before the shock, was a live and prosperous port, and one of the most ancient cities of Italy.

It was embalmed in the annals of history long before the Christian era, when it bore the name of Rhegium.

Previous shocks of earthquake, especially the great one of 1783, had left its scars upon the ancient palaces and the cathedral, but until that one terrible day in the Christmas week of 1908 it still nestled in fancied security at the foot of grim Montalto, which reared its vine-clad head almost five thousand feet towards the heavens to the back of the town.

NOW AN UTTER RUIN.

To-day, the city is in utter ruin, ruin as complete as that which wiped Messina off the map. Yes, worse! For the tidal wave here swept over the entire town, so deep that the bodies of fish were found, after the death-dealing flood finally had receded, as high up as the third floors of a number of houses that were so sturdily built that their shells at least were able to defy not only earthquake, but flood and flame.

Could any human beings be expected to survive that shock, that flood, that fiery visitation that swept the still dripping ruins? Yet some few lived to tell the tale. Few enough. But some.

Not a scene of horror at Messina but had its ghastly counterpart here.

The tidal wave that swept into Reggio flooded the city to a depth of many feet above sea level. Some of the houses along the water front were swept from their foundations and dragged out to sea.

Twelve miles of the railroad near Reggio were destroyed.

The tempest added to the terror of the scene.

The few Reggio survivors wandered nude and demented about the ruins of the city searching for food.

Practically all the pupils of the Reggio College perished. The little

villas located on the heights alone escaped destruction. The chateau of Reggio was left a heap of ruins.

The prison collapsed, and almost all the convicts, estimated to number 1,800, lost their lives.

A group of travelers who were at the railroad station, awaiting the arrival of a train, were crushed under the debris of the building.

All the railroad stations in a radius of twelve miles from Reggio were destroyed.

The sea front was entirely swept away—so thoroughly undulated that for days seamen familiar with the coast from childhood could not recognize the place and believed that Reggio never had emerged from the waves.

And yet there was much ground for this belief. The ruins of Reggio finally did emerge. But it was ruins only. For days it was impossible to approach the site by either sea or land.

FACE OF COUNTRY CHANGED.

For a distance of twelve miles from the city, roads, bridges and foot-paths were destroyed. Even the face of the country was changed. It was impossible to get into Reggio even with automobiles.

Only a few thousands out of the entire population escaped death or injury.

Lieutenant General Fiera Di Cossatto promptly ordered that all looters and robbers be shot on sight.

Martial law was a necessity.

For many hours what was left of Reggio was completely isolated through interruptions to the telegraph and telephone and landslides that obstructed the railways.

No news of the stricken city reached the outside world until midnight, and then it came from Messina in the form of a dispatch which a torpedo boat, flying at full speed along the coast of the peninsula, carried from point to point, always finding the wires down, until it reached Nicotera, where the telegraph lines were found to be intact.

From this point the dispatch was sent.

After summarizing the immensity of the catastrophe the telegram

ended with the announcement that Captain Passino, commander of the station of torpedo boats, was buried under the debris after having with other officials performed heroic work in trying to save others.

The Capucine monks at Reggio escaped death and did brave work in rescuing the less fortunate. Of the twenty-one nuns at the Convent of San Vincenzo di Paola, only seven remain alive.

A tragic episode was the rescue of Deputy Demetrio Tripepi, Mayor of the town. His family escaped, but he disappeared and his children felt certain he was buried under the ruins. They set to work to find their father and they struggled with the ruins for twenty-four hours without rest and without food. Only a miracle, they thought, could bring him back to them.

Eventually, however, the father appeared. He was badly injured but still alive. The joy of the family was not for long, for the deputy died soon afterward. Giuseppe Valentino, another member of the Chamber of Deputies, also was among the dead.

HOT WATER GUSHES FORTH.

One young woman of Reggio was a prisoner for forty-eight hours on the fifth floor of her home. She called for help, which none dare give her because of the unsafe condition of the walls. Finally, when a fireman braved the danger and brought the girl down, she was found to have gone raving mad. Her mother and her father, two brothers and a sister, were lying dead in a room beside her.

The station master at Reggio says that immediately after the first shock a chasm eighty feet wide was opened in the earth. From this there gushed forth a flood of boiling water, some jets rising to the height of an ordinary house. Many injured persons who were in this vicinity were horribly scalded by the flowing stream.

As the station master made his way to a place of safety he saw human limbs sticking out from the masses of ruins. Frenzied relatives strove to free their dear ones from the fallen masonry, while shrieks from the miserable fugitives, rushing half naked and bleeding through the streets, filled the air.

The sea inundated the suburbs of Reggio and destroyed countless

acres of orange groves. The smaller houses of the peasants completely disappeared, the receding waters leaving them buried in mire.

Corpses were everywhere in the outskirts of the city. The bridge near Pellaro was carried off by the sea, as were also entire sections of the railroad.

The dead in Reggio were mutilated and distorted, their faces set in expressions of infinite terror and their poor bodies shattered and misshapen. Many of the injured died later. Of those who survived many appeared demented.

One man who had but one arm came out of a ruined house and started a ghastly dance. He cried out that the whole thing was only a dream, that Reggio was safe, and that his wife and children were uninjured and peacefully sleeping in their beds.

A laborer who escaped relates that shortly before daybreak a deafening noise like the roaring of a hundred cannon was heard. This was followed by the subsidence of the entire lower portion of the city. At the same time the sea swept over the water front. The cathedral, all the municipal buildings and the barracks and the beautiful palaces that lined the Corso in a moment were heaps of ruins.

After a brief period of paralysis, mental and physical, the work of relief began, but it did not take shape until the arrival of the King, days later.

STATE OF ANARCHY.

For forty-eight hours the crazed survivors had signalled in vain to passing steamships. All relief was hurrying to Messina.

Barely fifty houses in Reggio remained standing, and the streets and squares were filled with bodies, which were being devoured by clouds of ravens and crows.

A state of most frightful anarchy prevailed.

Mobs of ruffians roamed among the ruins, giving full vent to their vilest instincts. They were bent on pillaging the wrecked jewelry stores and banks and did not hesitate to shed the blood of those opposing them.

A few soldiers who escaped unhurt were impelled by an admirable spirit of discipline to organize patrols on their own initiative. They en-

deavored to protect the property left intact, but the criminals fought against them fiercely.

The number of these criminals increased to such an extent that the soldiers were forced to fire on them. It was only after a pitched battle, in which several were shot and killed, that a semblance of order was restored.

All entrances to the city, or what was left of it, were guarded by soldiers. Many of the survivors were lying exposed to the four winds of heaven.

As a precautionary measure against an outbreak of pestilence, the bodies of persons killed in the earthquake were burned, and strong disinfectants strewn among the ruins of the city.

The troops set up field kitchens for baking bread in the streets. Strong guards were placed over clothing and provision stores, in order to prevent their being pillaged.

Long term prisoners were embarked on board the battleship Napoli and others sent home.

The rescuers were forced to guard themselves against the onslaughts of hundreds of dogs, raging with hunger, which sprang upon all comers. They were shot down as fast as possible and not a few of them were grabbed by the starving survivors and used as food.

CHAPTER VII.

DEVASTATION IN SMALLER CITIES.—TERRIFIED CROWDS PRAY.—
LIVED ON DOG MEAT.—NO PART OF CALABRIA ESCAPED.—TER-
RIBLE FLIGHT OF BAND OF REFUGEES.

ALTHOUGH DEATH, the grim reaper, garnered his richest harvest at Messina and Reggio, the devastation over a vast stretch of territory was even greater in proportion to the population and property valuation.

Not a house in Castoreale, with more than 10,000 population, escaped. Only a few of the inhabitants survived.

Catania, with 146,000 population, was badly damaged by both the earthquake shocks and the tidal waves which swept the coast, but the loss of life was not so heavy as in some of its less fortunate neighbors.

Palmi, Casano, Cosenza, Bagbara, Riposto, Seminaria, San Giovanni, Scylla, Lazzaro, Cannitella and all the other towns bordering on the straits were swept into ruin in that one instant, in many cases not a single person escaping.

The gravest damage was done to public buildings and churches at Floridia, Noto, Chiaramonto, Vittoria Paterno, Terranova, Marianopoli and Naro.

At Mineo there were several shocks. At Augusta, which once before was destroyed by an earthquake, the tidal wave wrecked the Government salt works. The prisoners employed there mutinied, but were suppressed.

At Patti the shock was accompanied by a blinding flash of light, while serious havoc was wrought at Barcelona and many persons were killed at Montagano.

At Caltanissetta, a Sicilian town of 30,000 people, many houses were demolished. Vast crowds gathered in the parks and filled the churches, praying for deliverance.

Similar scenes of panic were witnessed at Mineo, a town one hundred miles southwest of Catania.

At Agosta, in the province of Syracuse, churches and houses were demolished, but few lives were lost. The prisoners in the jail escaped and dashed through the praying crowds on the streets for liberty. The troops were called out and quiet was restored.

There were several shocks also at Lindua Glossa, Santa Saverina and Noto, all in Sicily.

The Santa Maria College, at Ali, a little place between Messina and Catania, was overthrown, many of the girl students being buried in the ruins.

Horrible tales came from Calabria of fights between starving families for crusts and of fearful struggles for life between men and dogs. The terrors of famine and thirst were heightened by fresh occasional shocks of earthquake. Few of the survivors dared to go beneath a roof. In the open the rain fell heavily, mercilessly and unceasingly.

SUBSISTED ON DOG MEAT.

At the village of Bashone the inhabitants, isolated for days, ate dogs and cats and chewed leather. The only surviving doctor attended as best he could to the injured, but surgical instruments being sadly lacking he used pruning knives for amputations. Chloroform was unknown, and even bandages were missing, in most cases sacking being used.

So it went throughout all of the province of Calabria, as well as over the greater part of Sicily. Hundreds of thousands perished in the ruins of their homes. Hundreds, imprisoned among the debris or pinned down by the fallen beams and masonry were slowly starved to death while the frantic survivors alternately sought for food and tried to succor their less fortunate fellows.

To-day, the land of mythology, the home of one of the world's oldest civilizations, lies desolate. Nine-tenths of its population are dead. The survivors have fled, most of them never to return.

New shocks at Pellaro a week later precipitated the entire population into the sea, including both the dead and living victims of the first earthquake.

At Sant' Eufemia it was stated officially that the deaths there totaled

1500. The injured exceeded that number. The ruins were soon wrapped in flames.

An entire regiment of infantry was drowned by the first tidal wave at Palmi.

The devastation over the entire district was more or less complete. No part of the province of Reggio De Calabria escaped.

In more than one town the shocks caused gas meters to explode, and disastrous fires resulted. The flames helped greatly to swell the death list.

At Pizzo the dead numbered thousands.

The section around Pizzo experienced another earth shock a few days later, throwing the people into a state of panic. The remains of the church in Pizzo collapsed. A score of people within the building had a miraculous escape.

At Sant' Eufemia, a town of 6000 people, sixteen miles northeast of Reggio, the dead numbered 1500, the wounded exceeding that figure. The houses that were not destroyed soon were in flames.

Bagnara, on the coast to the north of Reggio, was practically wiped out, fire finishing the work of destruction. One report said that "all the inhabitants of Bagnara are dead." The town counted about 10,000 people.

TERRIBLE FLIGHT OF REFUGEES.

To the destruction must be added the following towns and villages: Castellate, Polisten, Cinque Prondi, Mamertina, Simpoli, San Procopio, Pizziconi, Stefanconi, Catona and Rosalo. These places are no more.

One survivor states that an express train on the road from Reggio to Naples was brought to a stop by the shock when about eighteen miles along the road in its journey. The passengers demanded that they be taken back to Reggio, where they found a scene of desolation. While searching for friends fresh shocks occurred and practically all the passengers were killed.

The tidal wave inundated a villa at San Giovanni, 2500 feet back from the shore line.

In Calabria, the region around Monteleone was most affected. The

village of Stefanaceni, the inhabitants of which numbered 2300, was practically destroyed.

Monsignor Morabito, the Bishop of Mileto, who distinguished himself in the earthquake of 1905, did valiant work again. He rushed into places where the ruin was greatest, and brought aid and encouragement to all.

The experiences of a band of refugees from Messina and Reggio, who made their way on foot into Palmi, was distressing beyond words.

They succeeded in getting away from the Sicilian coast in sailboats. After a frightful experience in crossing the strait they landed on the Calabrian coast. There they were met by haggard refugees from Reggio, and the various groups of unfortunates joined forces.

Together they painfully climbed the hills. At a certain point they all turned to give a last look at the burning cities. They stood on the mountain side plunged in despair.

TERROR OF SURVIVORS.

A young priest who had escaped from Reggio advanced toward the group, some 2000 persons in all, and blessed them. Then, turning in the direction of Reggio, he solemnly called down the blessing of God upon the desolated city.

"Peace the dying!" he cried. "Peace to the dead!" Men, women and children knelt on the ground and, raising their hands to heaven, prayed for the deliverance of the multitude.

The band then took up its broken and toilsome march to Palmi, where the refugees arrived ten hours later in a torrent of rain. Two thousand had set out in the beginning, but only five hundred ragged and emaciated wanderers reached their destination. The others had succumbed on the awful journey and fallen powerless by the wayside.

More appalling than the destruction of the towns and villages themselves was the terror of the survivors. The spectacle was horrible. The wounded, bleeding, ragged refugees were human skeletons, who staggered here and there, dragging their bruised feet with effort and staring vacantly in all directions.

Those less afflicted told contradictory stories. Each remembered only the tragedy of which he personally was the victim.

In the mountainous regions inland the population took refuge in grottos and caves, where peasants and priests, soldiers and persons of gentle birth lived in common. Their bed was the ground, and fires burned to keep off wild animals. In Albi alone 2000 people were homeless.

The Marquis Vincenzo Genoese, of Palmi, says he was awakened by a tremendous roar. It seemed as though the house was whirling around, like the wings of a windmill.

The wall of his dwelling cracked and through it came a cloud of suffocating dust. Stunned, but uninjured, the Marquis tried to escape to the streets, but the stairs had collapsed. He descended from a third-story window by a rope.

Walking, he says, was difficult, owing to the fact that the streets were filled with debris. He assisted in dragging from beneath the ruins eighty-six persons, all of them dead. The faces of every one of them showed the agony they had suffered.

Many had their arms across their faces, as though to protect themselves from the falling debris.

It was necessary to release the prisoners at Palmi, and many of them succeeded in making their escape.

TIDAL WAVE'S GREAT FORCE.

The Marquis tried in every way to enter the town of Reggio, but in vain.

Even in Palermo, at the other end of Sicily, heavy shocks were felt for days later. After one of these there was a general rush to the squares and open places, accompanied by lamentations and shrieks of fear, although later in the day the population invaded the churches and carried out the images of the saints and sacred vessels, then marched in a procession through the streets, imploring a cessation of the earthquake's scourge.

A relief train dispatched toward Messina in the hope of aiding the earthquake sufferers was forced to return, being able to go only within

ten miles of the stricken city on account of demolished tracks. The engineer said that all houses along the route showed effects of the earthquake.

A torpedo boat on a similar mission was forced to return.

While the destruction was due primarily to the earthquake, the tidal wave caused enormous damage.

In the narrow strait the water formed into a huge wave forty feet high.

It then drew back from the coast as if gathering strength for an onslaught that would obliterate the land. So violent was the motion of the atmosphere coincident with the tidal wave that several workmen engaged in digging a pit on the Calabrian side of the strait were carried bodily up into the air.

Suddenly stopping in their backward sweep, the waters of the strait hurled themselves up on two coasts. Inexorably they advanced, and piers, houses and gardens were swallowed up in the flood.

TIDAL WAVE TEN MILES INLAND.

At some places on the coast of Sicily the waters swept over the earth for a distance of ten miles. The ground for a great distance trembled under the shock of the impact. A naval officer who witnessed this awe-inspiring spectacle described it in these words:

"It seemed as if two mountains, one of water and the other of land, fell furiously, the one towards the other, and as if the land vomited human habitations into the sea."

At Catania, scarcely had the first spasm of terror passed when the tidal wave spent in from the sea. Shouts of warning arose, and the people, who had just fled from their houses, ran shrieking away from the docks and water front into the towns where a minute before the danger had seemed greatest.

Where the sailors could get ashore, vessels of all kinds were abandoned. The waters came and left devastation in their wake. Many perished, but the water's rush carried everything before it.

Scores of fishing boats were swamped, and steamships in the harbor were damaged.

The sights witnessed in the stricken district will live long in the memory of one man, at least, who traversed the region immediately after the disaster.

After tramping thirty-one miles without food or drink, during which time he encountered throngs of the destitute and hungry, he arrived at Messina, footsore and tired. From there he went to Palmi and thence to Reggio.

At Bagnara he saw what was left of the populace roasting sea birds for food. The Mayor's house, he says, was perched high on a rock overhanging the sea.

At Scylla he attempted to rest, but this was impossible, for every building was in ruins.

Continuing, he says:

"A few kilometers further on, Cannitello presented a still more terrifying sight. Almost at the same moment as it was overthrown by the earthquake, it was swept by the sea. It was no more.

"The country was but a charnel house, whence a horrible stench arose. All the houses were heaped into one pile of ruins, under which the dead and wounded lay. The sea round about was covered with household articles and children's playthings.

"THE TOMB OF REGGIO."

"From the ruins muffled voices calling for help reached us time and time again. I asked a fisherman the number of the dead and saved. 'The survivors—perhaps five, six or seven; the dead—perhaps two thousands, three thousands—who knows?' he answered.

"The once prosperous San Giovanni was another awful sight. The tidal wave smashed the jetties and overturned the six moles and swept the entire passage. The railroad station, the wireless station, six ferry docks and the hospital are all destroyed. Four thousand inhabitants were buried beneath the ruins.

"The witnesses of that terrible night relate that the sea rose up as though lifted by a subterranean explosion.

Survivors here and there were huddled in wagons which were half buried in the sand by violence. They were wounded and naked. Not a

soldier had arrived; not a morsel of bread remained. When we found them they were worn by a struggle over a few provisions they had discovered in a freight car, but these were gone.

"Fifteen kilometers further we entered the tomb of Reggio. Those who saw Reggio a few weeks before would not be able to restrain their tears. I wept like a child as I saw outspread before me, where the town had stood, an ocean of ruins. Nothing was standing; all were dead; all had been killed. Palaces, churches, theatres and banks no longer exist.

"The jetty with its two stations, had been carried away to sea. A car was standing close at hand. Against this a girl of twelve had been hurled. The girl's head was cut off and floated out to sea; the body hung on the jamb of the car. The waters had poured down the Via Marina, cutting off retreat and drowning those who had not already been killed. The two other main thoroughfares, the Corso Garibaldi and the Corso Ascheneuse were completely obstructed by enormous heaps of blazing ruins. I was stunned at the completeness of the disaster.

"Never in imagination have I felt so strong an impression of death; not a soul living in this smoking charnel house; not a human voice. It was a terrifying silence. Ruins were piled upon ruins. Among the debris I saw furniture and women's clothing. A house cut in two revealed three stories, a red, very red, parlor bed, in which a man lay dead, crushed by a falling beam; a bridal chamber, from which the bride seeking to escape, also lay dead on the threshold; another, a parlor, in which there was nothing but a mirror and portraits of King Humbert and Count Cavour.

"I could bear no more. My heart bursting with grief and horror, I asked the eternal question: 'The survivors—perhaps five or six thousand; the dead, perhaps 25,000 or 30,000, who knows?'

"I obtained a rowboat and crossed under a beating rain with death in its soul, the sinister strait, still agitated by the horrible crime it had committed."

CHAPTER VIII.

A KINGLY KING TO THE RESCUE.—QUEEN SAVES CHILDREN.—VICTOR EXPLORES RUINS.—NARROWLY ESCAPES DEATH.—HELENA HURT IN PANIC.—DUKE AND DUCHESS OF AOSTA JOIN IN WORK OF MERCY.

ALL Italy, paralyzed by the magnitude of the disaster that devastated Eastern Sicily and Calabria, was fired to an earnest determination to relieve suffering and succor the distressed by the noble courage of its King and Queen.

King Victor Emmanuel and Queen Helena, as soon as they heard the first tidings of the calamity, rushed to Messina on board the battleship Vittoria-Emmanuele. They disembarked immediately and made their way into the ruined city.

As soon as it was known that the King and Queen had come crowds of the terror-stricken survivors of the earthquake swarmed around the royal party, prostrating themselves in the mud and crying aloud for pity. This reception was too much for the Queen, who almost fainted.

Many terrible stories were told to the King in connection with the work of rescue. His Majesty lost little time in listening to a recital of difficulties. He immediately joined a rescue party, and labored as unremittingly as the others. He personally extricated several injured persons pinned under the ruins.

The Queen quickly recovered her courage and followed the example of her husband. She devoted her attention principally to the little children. She rescued with her own hands a little boy three years old, bleeding from many cuts and wounds, and herself carried him to the deck, where she handed him over to members of the hospital corps.

People wept from emotion when they saw the King and Queen. The women threw kisses to her Majesty. Both virtually were carried in the arms of their subjects.

The presence of the King acted as a general inspiration. Even the

wounded found fresh strength when they learned his Majesty had come among them.

An aged man who had been abandoned under a beam that apparently had crushed out his life, revived for a moment at the shouts of greeting to the royal pair. He stretched out his hand and raised his head long enough to call out:

"Now, I can die happy. Long life to the King."

He fell back and expired.

KING EXPLORES RUINS.

The King explored the ruins regardless of the danger to which he exposed himself. He was often moved to tears at the scenes he came upon at every turn.

The Queen spent most of the day in the wards of improvised hospitals, visiting the wounded, many of whom have lost all that was dear to them. Her Majesty often broke into sobs as she listened to their dreadful tales of suffering.

King Victor left Messina that night with Queen Helena and arrived early the next morning at Reggio, and after visiting the town in company with the Queen, re-embarked on a warship and visited all the wrecked villages along the Sicilian coast, everywhere meeting the same scenes of desolation. The next day he visited the villages and hamlets in Calabria that had been overwhelmed.

The visits of the King and Queen aroused widespread enthusiasm.

In spite of the universal mourning and distress the sovereigns were saluted when they disembarked by the firing of guns from the Italian and foreign warships at Messina. As the King and his party set foot on shore they were greeted with scenes of indescribable woe. His Majesty spoke highly in praise of the Italian soldiers and the sailors from the foreign warships for their heroic work of rescue.

He visited every quarter of Messina and Reggio, giving words of encouragement, praise and consolation.

The Queen talked with the wounded on board the ships, comforted the women, spoke kindly to the children, and promised assistance. Every-

where the visit of the sovereigns imparted fresh impetus to the work of rescue.

Nor did he shirk or shun personal danger of the gravest kind.

While standing in the streets of Messina he was nearly buried under the falling walls of a wrecked building.

Amid the gloomy and depressing horror which like a leaden weight oppressed the land that by all countries has been called the garden spot of Europe, two noble female figures stood out as guardian angels watching over the afflicted population. They were Queen Helena and another Helena, the Duchess of Aosta.

The Queen gave the sufferers her tears, and with her own hands bound up their wounds, using her handkerchiefs when other bandages were lacking. She gave also of her worldly possessions, including the rings from her fingers.

TWO NOBLE FEMALE FIGURES.

Public opinion was seriously concerned with regard to the safety of the King and Queen and the danger from tottering walls. The King frequently tried to persuade the Queen to rest or return to Rome, but she always refused, declaring that it would break her heart to abandon her husband in his labors for the country in its anguish.

The King was indefatigable.

He showed wonderful activity and endurance, leaving no point in Messina unvisited. He supervised the entire work in the fallen city, and the presence of his Majesty infused new courage and energy into the rescuers and the survivors, hungry and wounded as they were. Often he was surrounded by a crowd of victims who, as though the sight of the King had restored their strength, cheered enthusiastically and shouted: "We have a King; we have a protector."

The Duchess of Aosta, who still proudly signs herself a Princess of France, was performing miracles of love, pity and endurance at Naples, where the wounded were arriving in great numbers. This noble woman gave not only pecuniary help, but nursed the injured with demonstrations of affection. Children, robbed by a cruel fate of their parents and relatives, found in this Princess a new and tender mother.

King Victor Emmanuel later returned to Reggio. He traversed the ruins from one end to the other, comforting the sufferers and cheering the rescuers. At one point His Majesty came upon a man buried up to his waist in debris. The King encouraged the unfortunate while the soldiers were digging him out. In the midst of the efforts at rescue the man cried:

"Sire, I can wait for deliverance, but for God's sake give me food and drink."

KING REBUKES PHOTOGRAPHERS.

Meeting a group of photographers engaged in taking pictures of the sad scenes, the King chided them for their occupation.

"You had much better turn your efforts to succoring the afflicted," said he.

Both Helena the Queen, and Helena the Duchess of Aosta, were born on foreign soil, but to-day the people of Italy worship them for their love and devotion, and the unselfish service to the stricken sufferers given by these two women of high lineage has made them doubly dear to all Italians. This devotion was particularly strengthened by the Duchess conveying in her motor car many unfortunate little children from the bare hospitals to her royal palace at Capodimonte.

The Duke of Aosta also visited Palmi and all the surrounding villages. This section, after Messina and Reggio, suffered more heavily than any other. The Duke said to one of the aides with him:

"The catastrophe indeed is a scourge from God. The time has come when it is no longer possible to think about those buried in the ruins. All hopes of saving any of these unfortunates, after the days that have elapsed since the disaster, must of necessity be abandoned. All our efforts must be devoted to caring for the wounded survivors."

Queen Helena was injured at Messina. Her injuries were slight, but the news caused a shock to all Italians, for Her Majesty endeared herself wonderfully to her people by her heroic and self-sacrificing work among the sufferers.

A shock at Messina while she was there created a panic among the patients in one of the improvised hospitals. The Queen, who was close by, hurried to the scene and tried to allay the fears of the patients, who

were crowding through the doors to reach the open. She was caught in the crush and painfully but not seriously hurt.

It is said that nobody in Italy envied King Victor Emmanuel his errand of mercy more than did the Pope, who felt that his place was with the stricken earthquake sufferers.

Having been prevented from going there, His Holiness tried to keep in touch with the prevailing conditions as much as possible and offered the Bishops of the affected zone all that he could give. His gifts in money aggregated \$400,000.

The Pontiff never regretted so much the loss of the liberty he enjoyed as patriarch of Venice.

A DESOLATE BIRTHDAY.

Following the desire expressed by Queen Helena, the anniversary of her birth, which was observed a few days after the great catastrophe, was not attended by any of the usual festivities.

Her Majesty is reported to have said that she wished to celebrate the day by working doubly hard for the Calabrian and Sicilian earthquake survivors, whose sufferings she could not drive from her mind.

Her two daughters, Princess Yolando and Princess Mafalda, respectively seven and six years old, instead of buying birthday presents for their mother, turned over the contents of their money boxes to the relief fund.

The little Crown Prince, who is four years old, not wishing to be outdone by his sisters, parted with what has been his greatest delight, a completed company of tin soldiers, of which he is the commander. He took his toys to his mother, saying: "This is all I have; please send them to the poor children."

Premier Giolitti voiced the gratitude of the people toward the first woman in Italy, Queen Helena. The reference to Her Majesty was greeted with prolonged applause in the Italian Parliament, the members of the Chamber and Ministers rising to their feet.

"I cannot possibly think of any kind of rejoicing," said the Queen, when she gave orders to have her birthday celebration omitted, "while the nation is suffering such terrible mourning."

The Queen added that she intended to spend her birthday in nursing the wounded and in attending to relief work among the women and children.

Queen Helena turned a portion of the Quirinal Palace into a workshop, where a number of Italian women of high rank, dressmakers and working girls, sat all day long in the greatest friendliness, busily cutting out and sewing garments for the refugees.

The women were under the superintendence of the Queen herself, who, with her own hands, often guided fingers unaccustomed to work of this kind. Each afternoon there was a rest period of one hour, when all the women took tea together. As soon as the time was up the Queen inexorably commanded that the work be resumed.

The royal children, the Princesses Yolando and Mafalda, respectively seven and six years old, were allowed to be present and were established in a corner, delighted and busy cutting out and making dolls' clothes for the poor little Calabrian children.

They were promised that if they do this well they shall soon be promoted to making baby clothes. When this time came their cup of pride was full.

How the Queen came to establish this beehive was quaint. She called on a little dressmaker here whom her maid patronizes, to order some children's clothes, and sew for her personally.

HOW IT WAS STARTED.

In the midst of the conversation, the dressmaker remarked how difficult it would be to carry out so large an order, as she had joined a society of sewing girls, established to devote a certain number of hours every day to making clothes for the refugees out of their own pockets.

The Queen was so impressed that she invited them to the Quirinal, promising them the material if they would have the idea enlarged into the present organization. The Queen, in her element, was heard to observe:

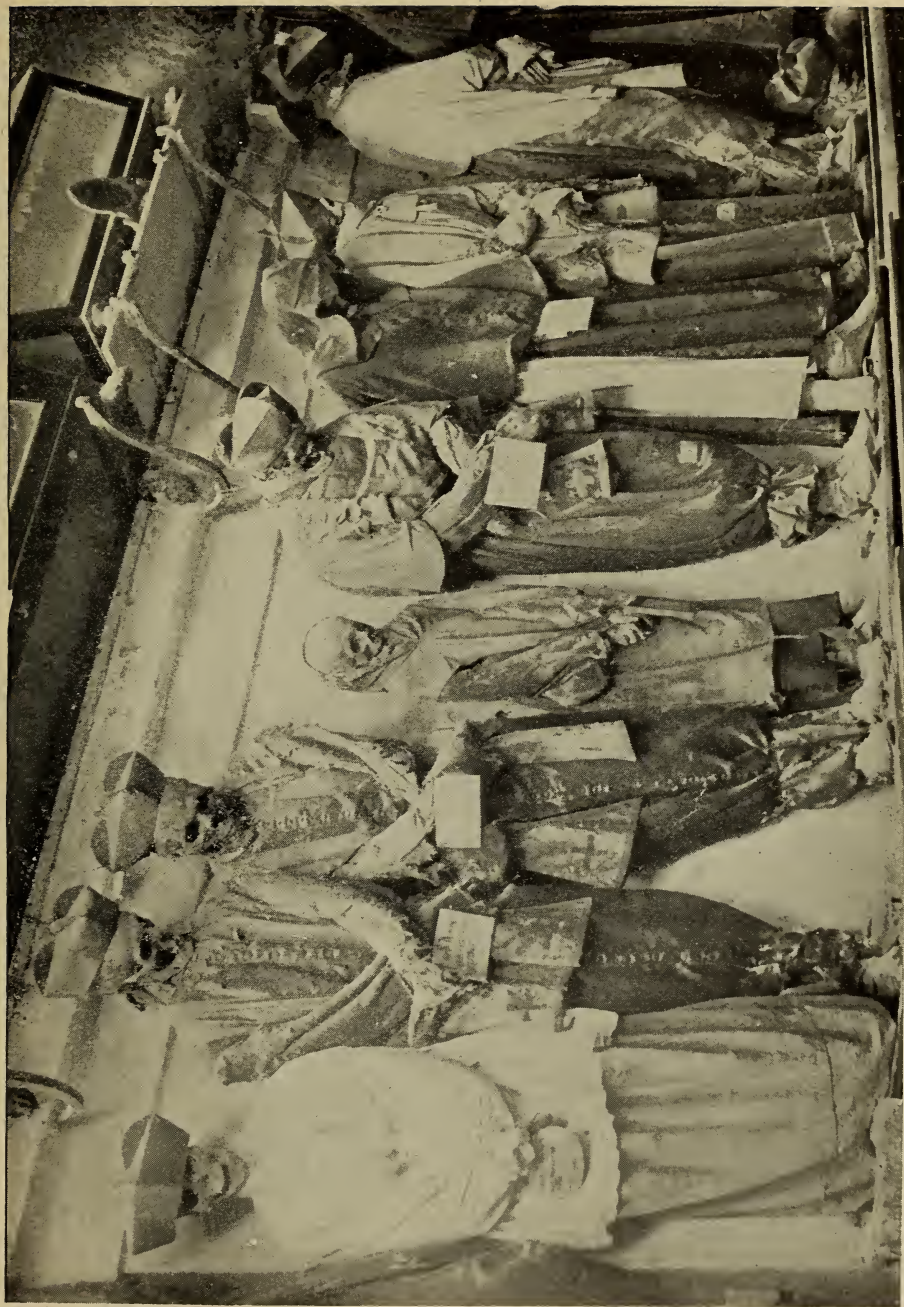
"If the cause was not so awful, these would be very happy days for me."

No wonder she was called in Messina "Our Lady of Mercy." Dur-

ing the sewing in the royal workroom many stories were told about the earthquake, the little Princesses being particularly interested in the story of an old woman looking about 100 years old, who refused to leave the ruins without her little treasure.

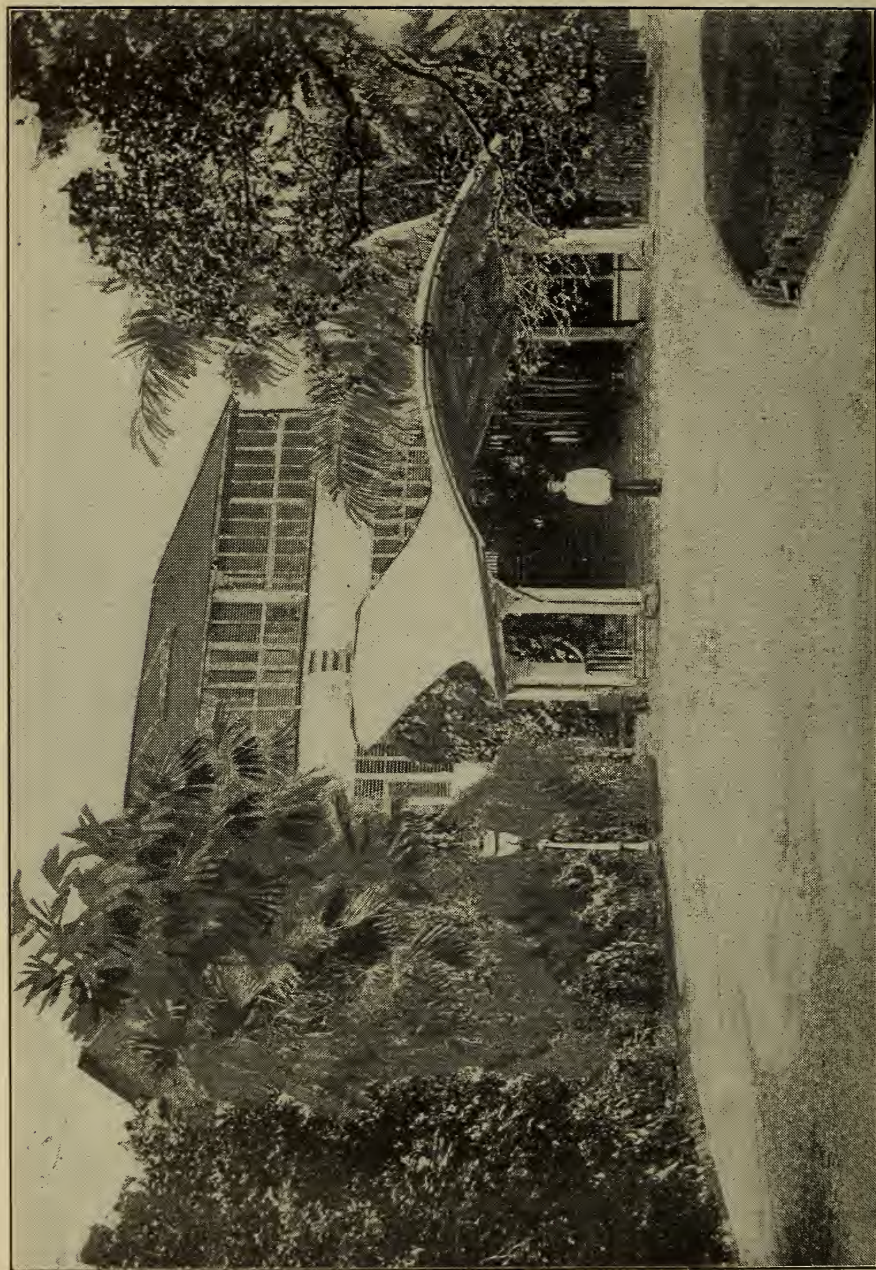
She was so obstinate that she had to be left to her fate. Another case is that of some sailors who heard queer noises under the ruins, evidently something human, so they dug on to find a woman and a child in a little shed which had resisted the shock and fall of debris, together with a goat, which yielded enough milk to keep them both alive. At last all got so weak they could not lift their heads, but all were alive when rescued, having given warmth one to the other.

Several children who were taken from the ruins in the first day when hunger was not so pressing cried and kicked until favorite dolls or toys were found, and one youngster was found still clasping a Teddy bear in his arms.



VIEW IN THE CATACOMBS AT MESSINA.

THE OBJECT OF GREATEST INTEREST TO THE TRAVELLER WHO VISITS MESSINA IS THE MONASTERY OF THE CAPUCHINS.



A POPULAR RESTAURANT NEAR MESSINA, SHOWING TROPICAL FOLIAGE

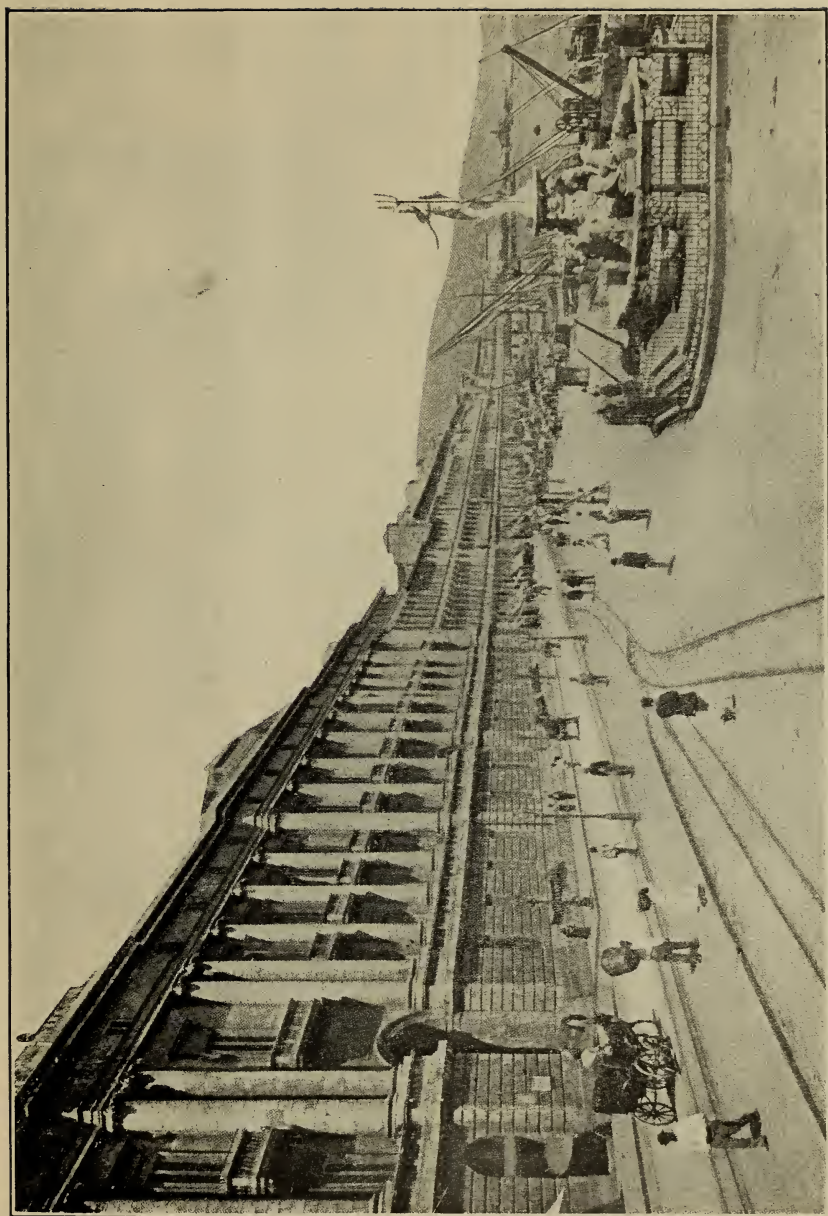


SCENE OF DEVASTATION AFTER THE LAST ERUPTION OF MOUNT ETNA

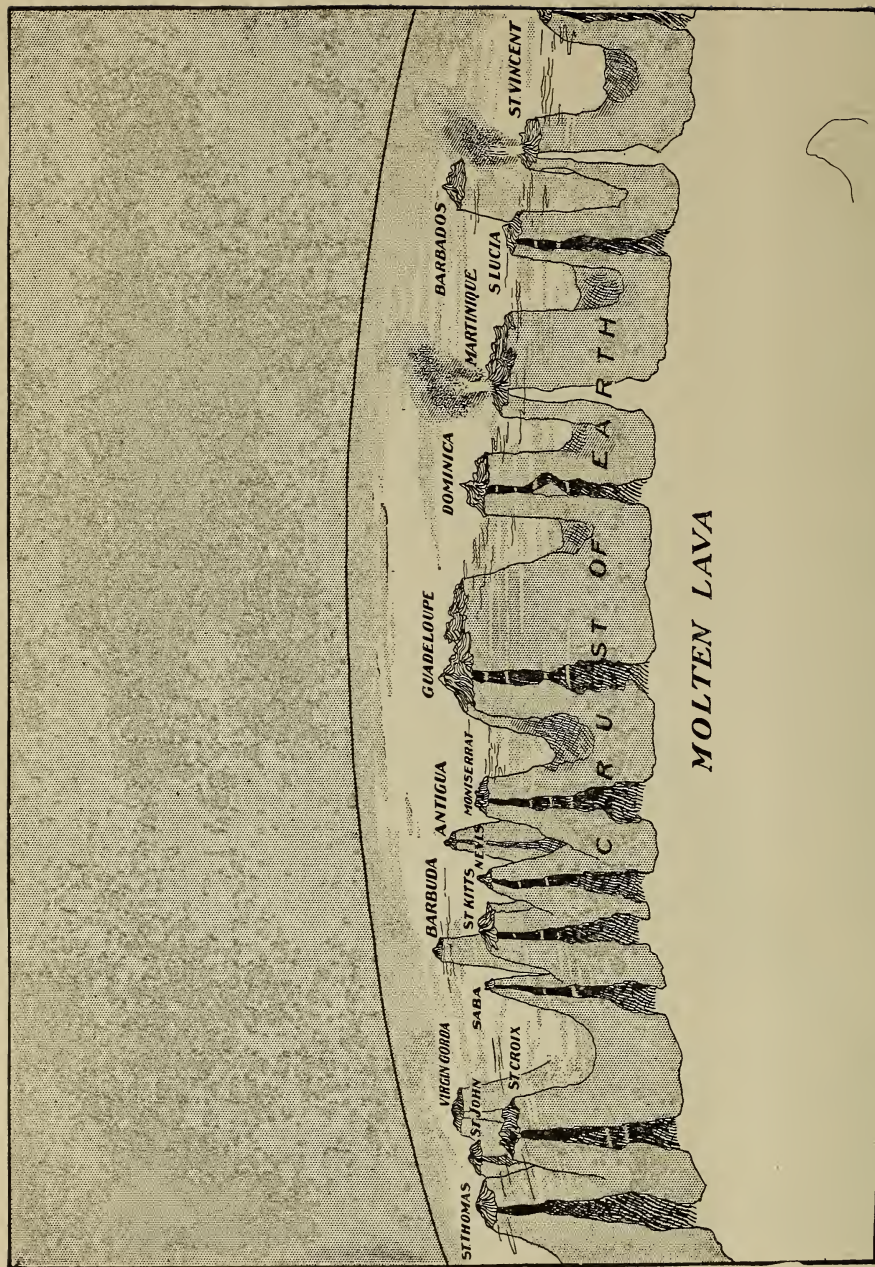


DONKEY AND CART, MESSINA.

THIS IS AN INSTANTANEOUS PHOTOGRAPH OF A SCENE WHICH IS COMMON IN SICILY.



THE AVENUE VICTOR EMMANUEL, MESSINA,
WHERE THOUSANDS MET DEATH BY EARTHQUAKE AND TIDAL WAVE.

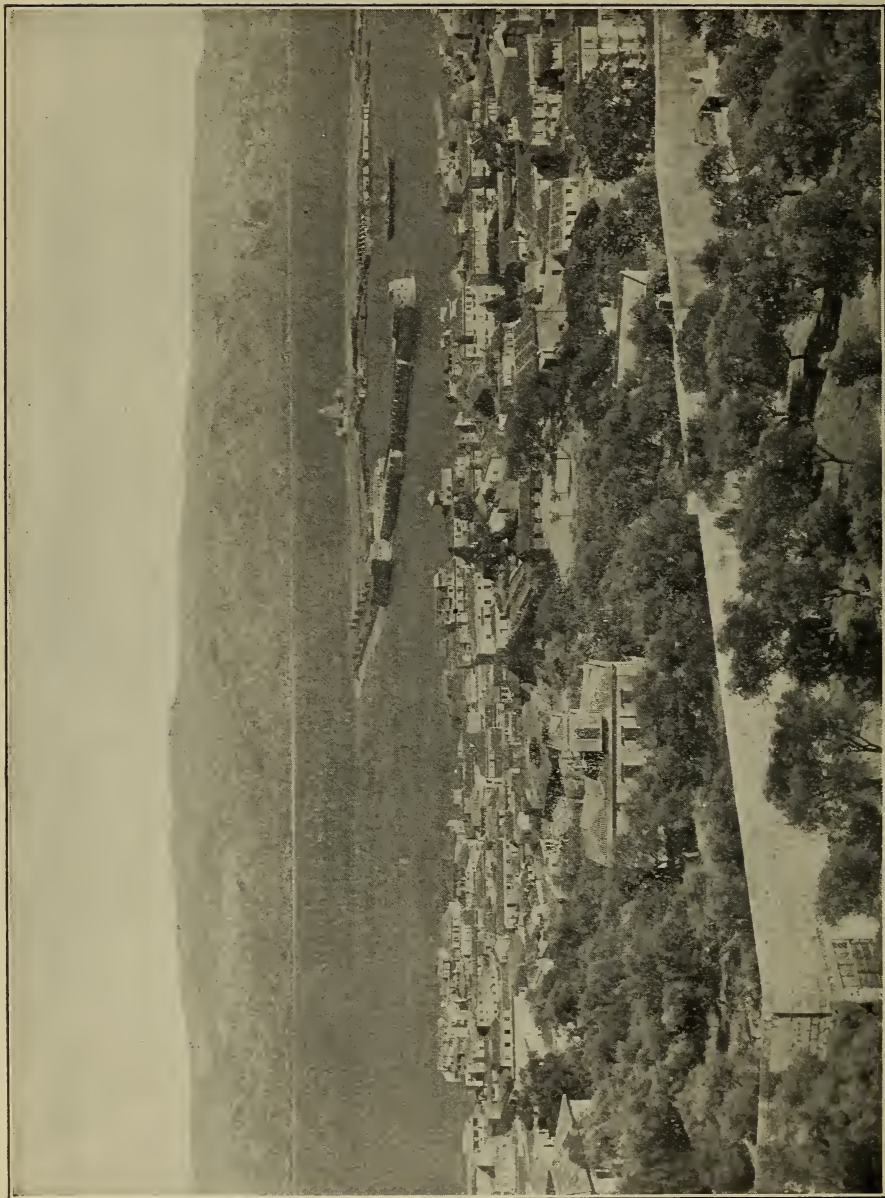


MAP OF THE VOLCANIC ISLANDS IN THE WEST INDIES

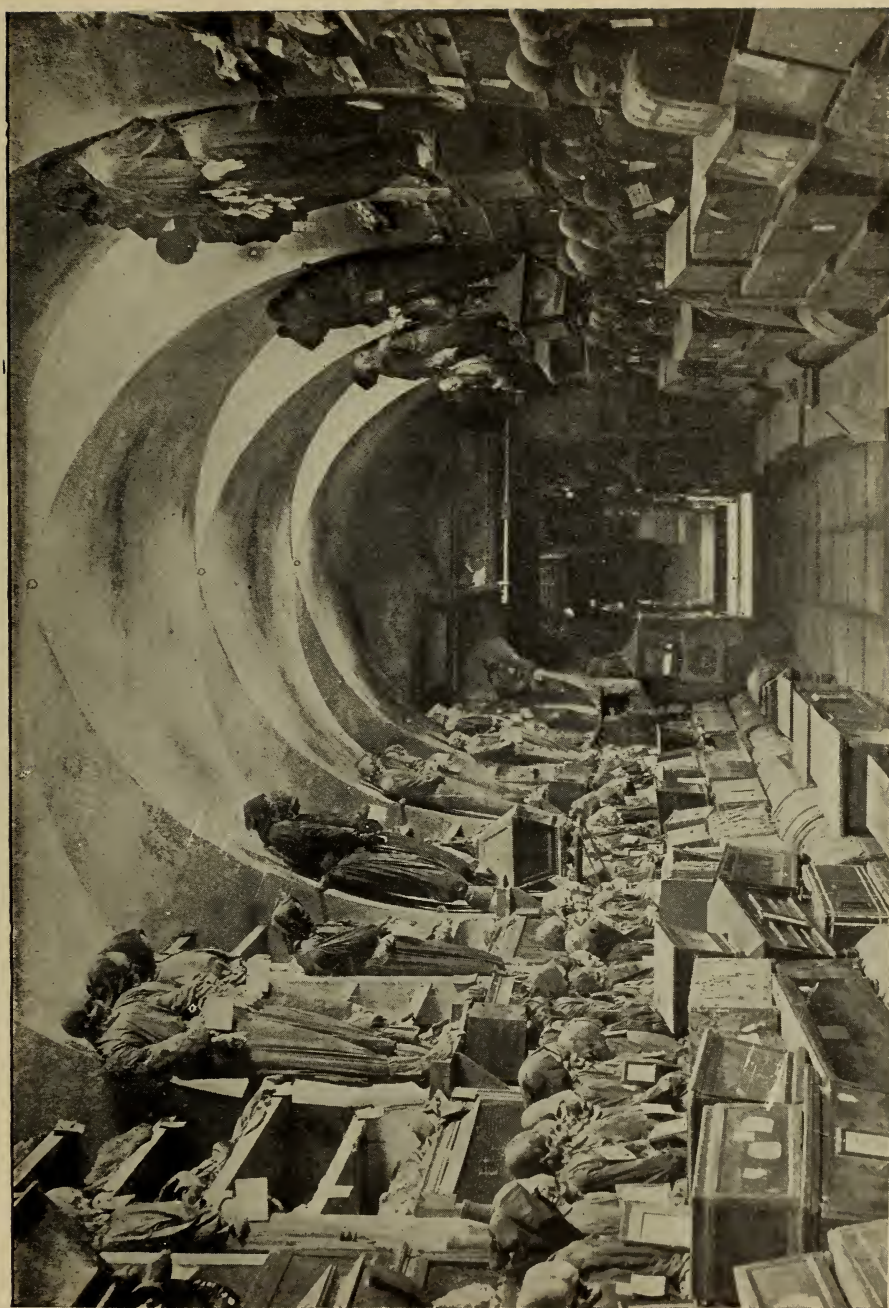
WHEN THE MOLTEN LAVA COMES IN CONTACT WITH WATER, THE RESULTING STEAM CAUSES EARTHQUAKES AND UPHEAVALS OR VOLCANIC ERUPTIONS



THE CELEBRATED AVENUE OF PALMS IN SICILY.

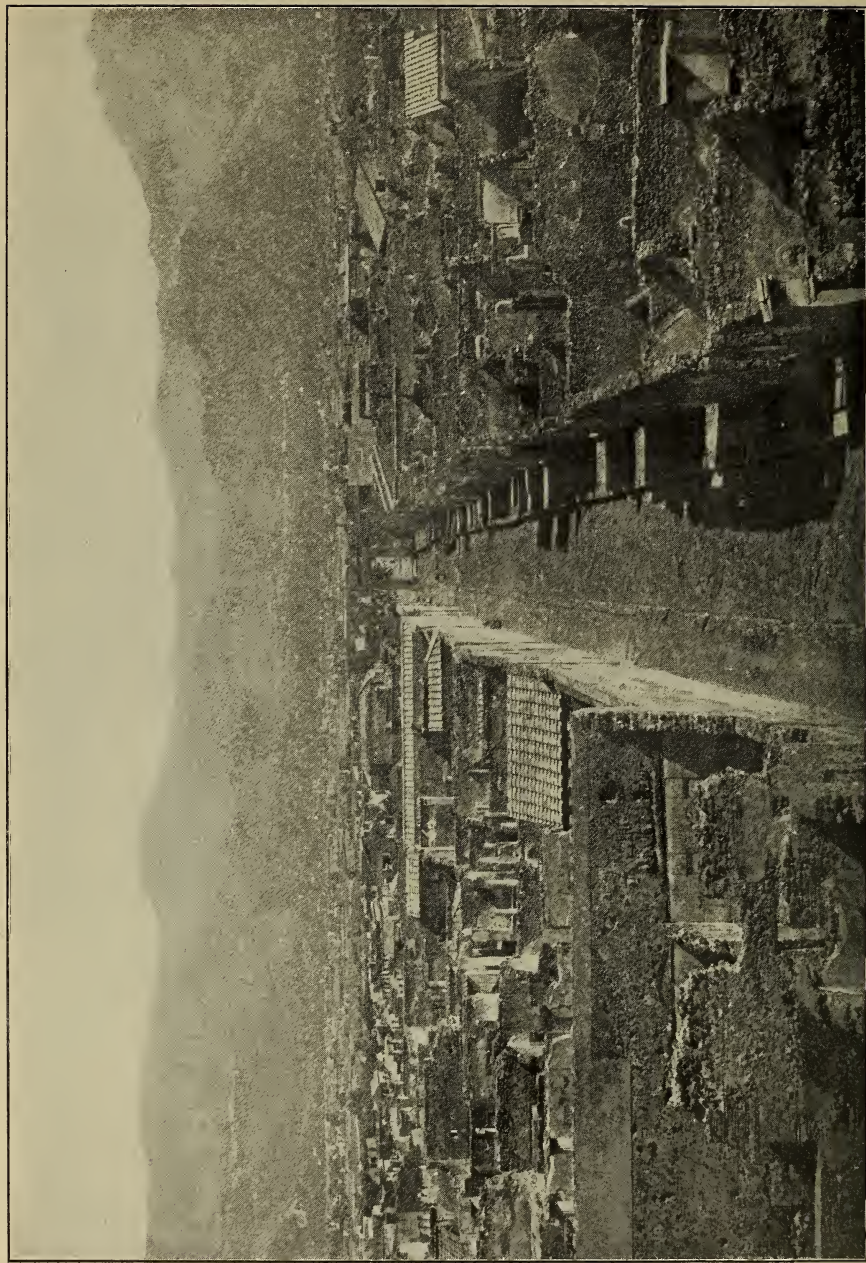


PANORAMIC VIEW OF MESSINA,
SHOWING THE STRAIT AND REGGIO IN THE DISTANCE.



SUBTERRANEAN VAULT IN THE CATACOMBS AT PALERMO, SICILY.

THIS PHOTOGRAPH SHOWS ONE OF THE VAULTS IN WHICH ARE PRESERVED THE MUMMIFIED BODIES OF THE INHABITANTS OF PALERMO, THE WEALTHY ARE IN COFFINS, THE POOR ON THE WALLS.



BIRD'S-EYE VIEW OF THE RUINS OF POMPEII

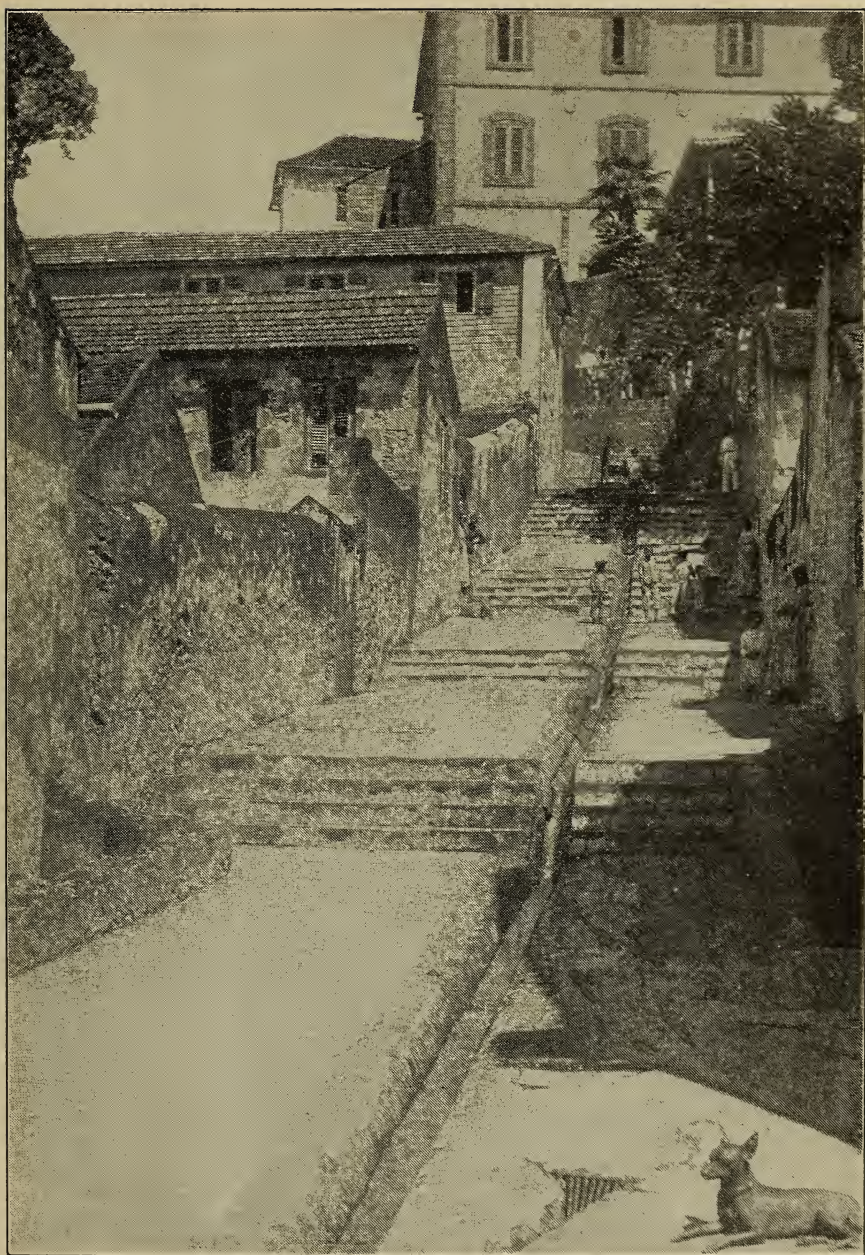


VOLCANO IN ACTION.

**THERE ARE TIMES WHEN THE ASHES ARE CARRIED HUNDREDS OF
MILES BY THE WIND.**



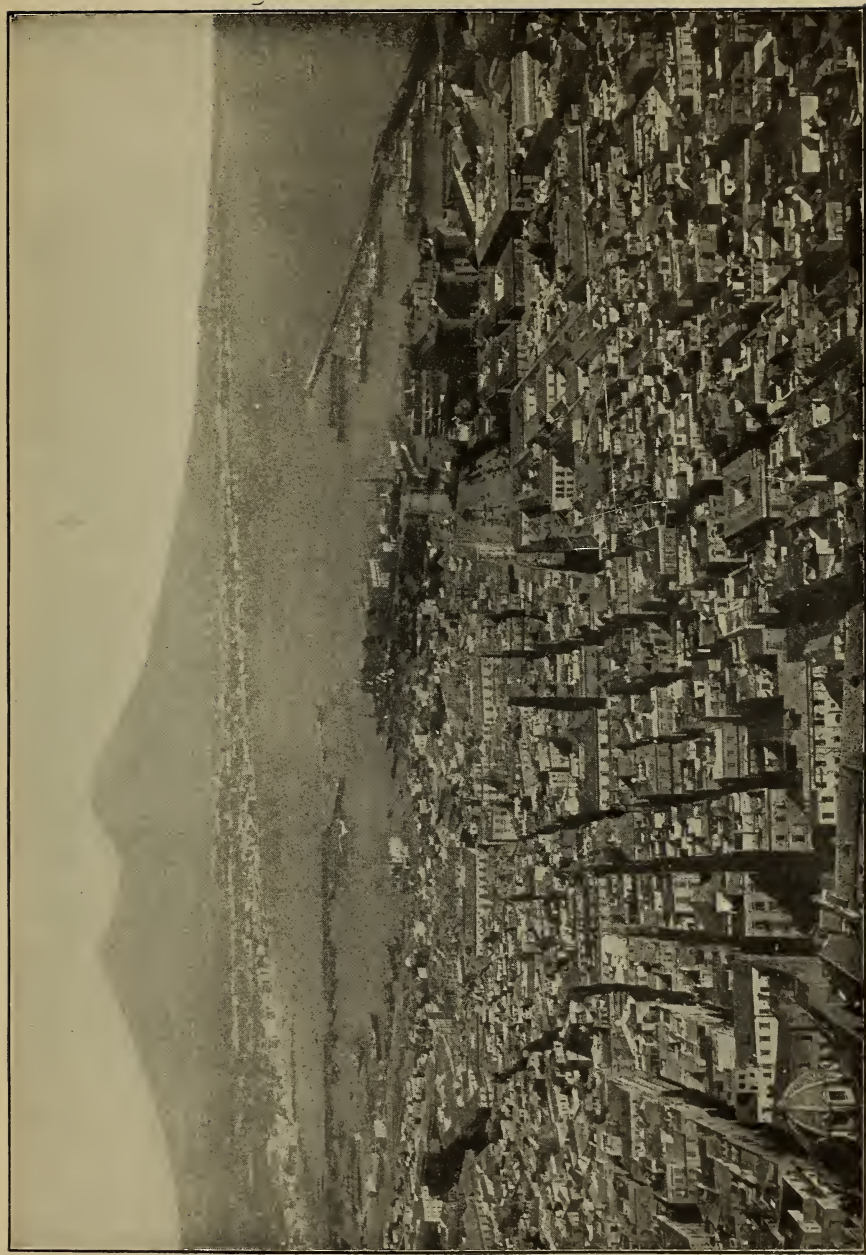
BURIAL PLACE IN THE MONASTERY AT PALERMO, SICILY.
THE ABOVE PHOTOGRAPH SHOWS ONE OF THE FAMOUS UNDERGROUND TCMBS.



A PICTURESQUE STREET, MESSINA.



SCENE IN POMPEII SHOWING STREET OF SEPULCHRES



BIRD'S-EYE VIEW OF NAPLES SHOWING MOUNT VESUVIUS IN THE DISTANCE



WATER-CARRIERS OF MESSINA.

CHAPTER IX.

BURYING DEAD IN TRENCHES.—QUICKLIME TO DESTROY BODIES.—AN IMPRESSIVE FUNERAL CEREMONY.—AMERICAN QUIETS THEIR FEARS.—PROPOSAL TO MOVE CITY.

AFTER comparative quiet had been restored and the Italian people had recovered from the first shock of the horror, they faced most terrible problems of the future—yes, and of the immediate present.

In the first place, though many thousands perished, there were other thousands, many of them maimed and incapacitated for work, who must be transported, temporarily at least, to some habitable regions, clothed and fed.

Next, to avoid a pestilence, there were yet more thousands of bodies to be dug from at least the upper part of the debris and buried, or, in any event, destroyed by quicklime.

This latter expedient, which did much to avert an epidemic, was proposed by the King himself, while face to face with the horror of the situation. He fully realized the menace of any other course and himself issued the orders for its use.

Of the bodies buried, hundreds were thrown into trenches and covered with the destroying agent.

A most impressive funeral ceremony was witnessed near Messina, about a week after the disaster, when Archbishop Barrigo made his way through the town, through the ruins of the city, to the cemetery at Mare Grosso, and blessed a grave 100 feet wide and 30 feet deep, containing 1300 bodies. The dead were piled one on top of the other, and covered with quicklime.

The prelate was followed to the cemetery by a large gathering of survivors whose lamentations mingled with the Latin words of the service and benediction.

Subsequently, the Archbishop walked through the ruins and blessed the military hospital, the military college, the barracks and the Archbishop's house, considering these wrecked edifices as so many ceme-

teries. Under them were the corpses of soldiers, students, policemen and monks.

With the exception of Sant Andrea Avellino, all the churches in Messina were destroyed.

GRAVE FEARS OF PESTILENCE.

The gravest fears were felt lest a pestilence should break out, and accordingly the government surrounded Reggio and Messina, as well as several of the smaller towns, and would let none pass except those who held passes.

This was rendered doubly necessary since shocks continued for days afterward. As many as ten an hour were recorded, causing many of the weakened walls to fall.

The Italian fears of an epidemic were partially born out by a number of cases of typhoid fever which broke out among the workers in the ruins, but the authorities were greatly comforted, during the height of this crisis, by the opinion of one of the foremost authorities of the world, Surgeon General Wyman, of the United States Public Health and Marine Hospital Service.

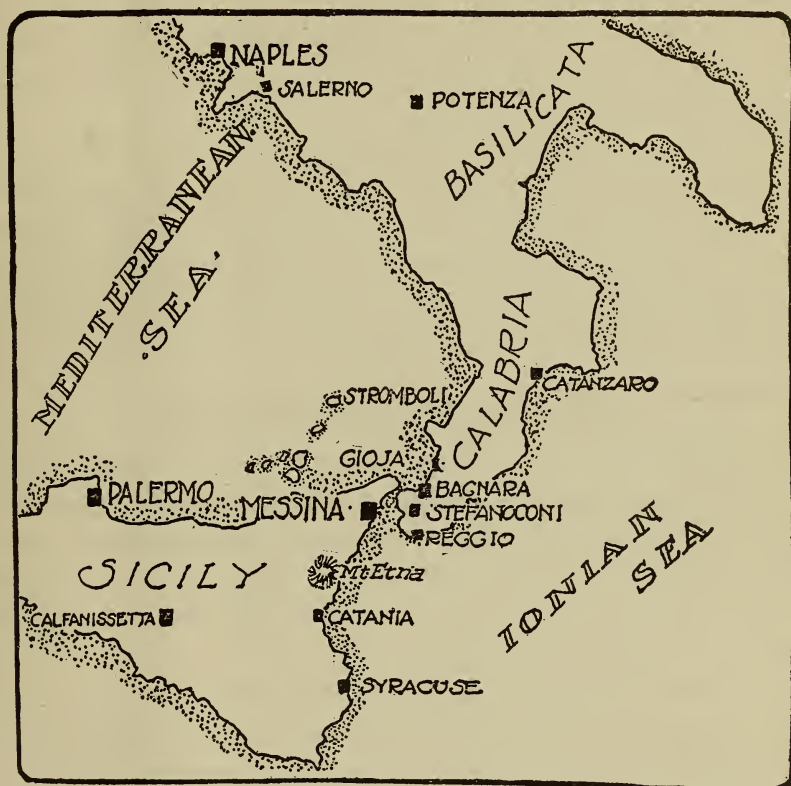
"Judging from modern instances, it does not seem probable that any great epidemic will follow the earthquakes in Italy," he declared. "Of course," continued the Surgeon General, "if a disease is already existent in a place, a convulsion of nature, such as an earthquake, with destruction of buildings, the breaking of sewers, interference with pure water supply and other consequent unsanitary condition, would tend to cause an increase of cases, but there is a popular misapprehension as to the real danger.

"If, for example, the plague existed in Messina at the time of the earthquake, doubtless conditions would arise that would favor its spread. But plague was not there. The same might be said with regard to cholera or even smallpox.

"The mere decomposition of bodies dead from accident does not of itself give rise to disease. In 1893 a violent storm caused the inundation of many of the islands contiguous to the coast of South Carolina and great apprehension was felt that on account of the large number of dead

animals unburied, the occlusion of drains and the filling of the wells with salt water, epidemic diseases would break out.

"The territory involved covered 150 square miles, but sanitary work was conducted by the Marine Hospital Service, and although careful records of disease were kept, it was demonstrated that no disease of an epidemic nature developed.



MAP SHOWING COUNTRY DEVASTATED BY EARTHQUAKE AND TIDAL WAVE.

"There is no record of epidemic diseases following the great fires at Boston, Chicago and some of the other large cities of the United States.

"It is observed that there was some appearance of typhoid at Messina following the earthquake, and this disease might naturally be expected to spread to some extent, due to the overturning of all sanitary conditions, and if the people are placed in camps there may develop some

typhoid there, but the sanitary department of the Italian Government is an excellent one and entirely capable of dealing with this condition, and while there may be possibly some increase of typhoid, it is not to be expected that there will be a great epidemic of it.

"It will be recalled that at the time of the Johnstown disaster in 1889 great apprehension was felt as to the spread of epidemic diseases, but there was no such spread. The same was true with regard to St. Pierre, Martinique, destroyed by the eruption of Mont Pelee. Great apprehension was expressed and preparations made to combat epidemic disease, but there was no outbreak.

"The same may be said as to the Galveston flood in 1900.

"In San Francisco at the time of the earthquake in 1906 there was no immediate outbreak of any infectious disease, although the sanitary conditions for a while were bad and some typhoid developed in the camps, but conditions were rectified as soon as possible, and for a time there seemed to be no epidemic results from the earthquake and fire.

PROPOSAL TO BOMBARD CITY.

"Later it was found that there had been in San Francisco some rats infected with plague, and conditions favored the multiplication and spread of plague among them until finally it affected human beings. No great epidemic, however, followed, there having been only, in the course of two years, 160 cases, with 78 deaths, and no cases among human beings since February, 1908—a year ago.

"Following these great convulsions of nature there might be, in addition to increased sickness and death caused by exposure and hardships, epidemic diseases of various sorts due to the unsanitary conditions prevailing were it not for the fact that invariably the first work undertaken is the disposal of the dead bodies and the rectifying of the bad sanitary conditions and in modern times the importance of proper sanitary conditions is so well understood that any civilized community begins at once attending to this very important matter.

"So that, as said before, there seems to be no great ground for fear of a large epidemic following the earthquake at Messina."

Another proposal, which yet may be carried out, was to bombard

the city by battleships as soon as all the more readily recovered valuables were gathered up and thus destroy any chance of further deaths from falling masonry.

Only one house in all Messina is habitable. It was constructed by a reputed eccentric, who for years past has been strengthening his residence with iron bars and other ingenious devices, in order to make it strong enough to resist an earthquake. The loss from a bombardment, therefore, would be small indeed.

The result of such a plan would doubtless be to remove the city bodily to some more favored site, probably Syracuse, since Catania is even more dangerously near Etna than was Messina.

Another project was to transfer Messina provisionally to Milazzo, a small town near the ruins of Messina on the north coast of the island.

It is estimated that about \$15,000,000 would suffice to rebuild Messina for 50,000 inhabitants, making it a commercial and maritime centre.

It would take about \$8,000,000 to rebuild Reggio for 25,000 people. In any event many years must elapse before the thoroughly terrorized populations can be induced to return to live in the stricken territory.

Should the Italian warships engage in battering down the walls still standing in Messina, the project of rebuilding the commercial port at Syracuse cannot contemplate making use of the stones and marble still utilizable in the ruined city.

CATANIA IN LAVA ZONE.

According to the accounts, while the buildings crumbled under the zig-zag shaking of the earth, the stones were not fractured as at San Francisco. Possibly this was due to the extraordinary bath supplied by the sea, which, rising as high as the highest building, submerged the burning city in a quenching flood.

Nor will the new Syracuse, as the inheritor of the destroyed Messina, benefit from an accession of population, as probably less than ten thousand of the more than one hundred thousand credited to the city were saved. Even these have scattered northward, fearing to remain on land devoured every little while by earth convulsions. But even the Ca-

tanians, long the rivals of Messina, are uncertain about remaining within the jaws of the monster, for Etna is very much nearer Catania than Messina. Nor is the harbor at all to be compared with Syracuse, which, without much labor, could accommodate the navies of the world.

Catania, which is just south of where Messina stood, is a thriving city and continuously growing, but the city has suffered quite as often, though not so severely, as Messina from the outbreaks of Mount Etna. Some of the most startling scenes of earthquake encroachment are identified with Catania, while the series of plateaus extending from the upper ridges of Etna, almost to the outskirts of Catania, are a dismal reminder of the irresistible might of the crater when it once begins to spill destruction from its insatiate brim.

The channels from the crater toward Catania mark very distinctly the different outflows of mountain, for each side of the lava streams are sometimes a mile wide; the dank green of the vegetation brings into more desolating relief the furious wrath of the molten stream which burns everything that it encounters. At one point a few miles from Catania, as if by miracle, the stream was stopped at its last eruption, leaving a wall like a battlement. The pasantry for miles about attribute the sudden stoppage at this point to the interposition of the patron Saint Agatha, a relic of whom is reverently preserved in the Catanian Cathedral.

USELESS A HUNDRED YEARS.

As it requires about a hundred years to transform the lava into fertilizing soil, the vast sweeps of brownish terraces make a landscape alternating in parasiac verdure and desolating emptiness. The very loveliness of the country intensifies the abomination of the lava desolation, for exotic plants as sensuously gorgeous as are to be seen in the Nile lands are common culture all over the southern segment of the Sicilian Island.

In natural scenery the picture far surpasses anything to be seen in the wonderland of Italy itself, yet beyond the industrious students of people and places, Sicily is inexplicably unknown to the tourist world, always alert for "sensation."

A company of capitalists who have returned from New York to their

native land feel so certain of the greatness that Syracuse inherits from Messina are already in negotiation for the nearest ground to the fountain of Arethusa on which to erect "an American hotel," to be in time for the influx that is sure to follow the "boom."

Sentiment and money making couldn't devise a better site. For the fountain to this day invites the delight of the visitor. It has been walled in by marble battlements to guard it against pollution and holds about the same place in popular reverence that the fountain of Treves enjoys in Rome.

The stream which issues from the solid rock forms a considerable body of water and glides away as clear as an Alpine "brunnen" to mingle with the harbor waves a mile or more away.

The Arethusa waters were guarded in the same way in Cicero's day, for he takes pains to mention that "In the island of Ortygia there is a fountain of sweet water, the name of which is Arethusa of incredible flow, very full of fish" and that it would be overwhelmed by the sea were its waters not protected by a rampart and wall of stone.

A FAMOUS FOUNTAIN.

Before the beginnings of man, as known to modern times, Arethusa is said to have made use of the delectable pool to bathe with her nymphs. This memory seems to have been lost to the inhabitants during many a century, for it was only a few decades ago that the pool was rescued from the washerwomen of the outskirts, who dipped the soiled clothes of the numerous suburban families in the precious waters.

Syracuse possesses many a memorial of majestic significance with which to divert the curious in its coming day of greatness.

In the centre of the Ortygia peninsula, which forms the modern city, greatly resembling Manhattan island in its conformation, stands a duomo, or cathedral, linking a very distant past with the banalities of to-day.

The cathedral "Santa Maria Del Piliero" (Saint Mary of the Column, or Pillar), was built by the Greeks six hundred years before Christ to do honor to the goddess Minerva. Shortly after the apparition of Saint Paul the Christians managed to obtain possession of the edifice and transformed it into a place of worship of the new God.

Disentangling the various relics of changing creeds will furnish the studious tourist with enlivening occupation, for the Christian edifice was transformed into a Moslem mosque, then into a Greek church, and to-day a Roman temple of worship.

Though remodeled by Christian and pagan, the same columns and material compose the edifice, so that with history in hand the visitor may see in his mind's eye the procession of diverse worshippers that celebrated devotions to the unknown god. There Archimedes, in the intervals of his scientific inventions, repaired to consult the oracles; there Marcellus, the Roman conqueror, forbade his soldiers to enter, but he couldn't stop the vandal pro-consul, Verres, from looting the temple of its incomparable statuary which he employed the legions in carting away by night.

To the art folk the most interesting relic of the past is a more than lifesize statue of Venus Anadyomene, discovered in 1804 by the Marquis Landolina in his gardens. Connossieurs hold this ample figure in finer work of art than the Venus de Milo in the Louvre, or the Venus de Medici in the Pitti Palace. This Venus Landolina is said by the learned to be a celebrated work modelled in Athens for the unspeakable Roman travesty of an Emperor, Heliogabalus, who in a moment of generosity presented it to the city of Syracuse. Though the head and right arm are lacking, the figure is held by art folk to far transcend in benignant grace any other Venus in existence.

REMINISCENT OF PLUTARCH.

Should Syracuse inherit Messina's fortunes, the readers of Plutarch will be apt to revive their interest in one of his heroes at least. Timolean, who among all its vicissitudes, the city commemorated as its "grand old man." Timoleon, according to the devout belief of his contemporaries, "was favored by the gods wherever he went."

It was Timoleon (another Cincinnatus in conduct) who quit sequestration to rescue his compatriots from a swarm of tyrants and ended by routing the theretofore invincible legions of Carthage.

Even walking through the streets of the city, the tourist would feel

as if he were a contemporary with the worthies pictured in Plutarch's pages or in the stunning war and sea pictures of Thucydides.

A narrow and winding way named in honor of the mother of Venus, Via Dione. Another the street of the Duomo leads into the "Piazza Archimedes." La Via Maniace recalls the great captain who routed the Carthaginian armies. The "Passage Aretusa" shows that the city councils had sentiment in their political ministry of the people's affairs. Just outside the remote walls are the remains of two Doric columns which in Syracuse's great day marked the city's veneration for Timoleon's Archimedes.

The bones of the worthies are not identified with the columns indeed, even in Cicero's time there was dubiety as to the exact whereabouts of the tombs of Timoleon and Archimedes, though their names were always on the tongue of the public orators.

SARACENS CAPTURED CITY.

Cicero writes that he found the monument of the illustrious men "covered with brushwood and bramble" so that the monument was unknown to the Syracusans who even denied its existence.

The wretched Syracusans, however, may be excused for not knowing exactly where their great dead were buried, since when the Saracens captured the city in the year 878 before Christ, it was devastated about as thoroughly as Mount Etna did its work on Messina the other day.

Miles of mounds, broken columns and mouldering fragments of what were once colossal edifices, still make clear that in even those early days enterprising citizens had the modern fever of "greater cities."

When Ortygia, the peninsula, became crowded, the city extended across the narrow channel and took in finally Acradina, Tyche, Neapolis and Epipolae. Ortygia was known as the inner city, the other four as the outer.

These were enclosed by a wall one hundred and eighty stadia, or about twenty-five miles, in circumference.

That wouldn't be much, compared, say, with Philadelphia, but it must

be borne in mind that private dwellings took up no such space in the early days of the world as they do to-day.

Even the walls strong enough to resist the energy of the most valiant warriors of the world, have crumbled away.

When the greater Syracuse was in its prime, the harbor was walled by the city, for nearly four miles, and in that sheet of water some of the most terrific sea fights of antiquity were witnessed by the millions of citizenry, for in those days there was no danger of flying missiles to force the spectators to remain at a safe distance.

Scores of military students during the last hundred years have retold the incidents of the fight at Actium, one, a French admiral, actually naming many of the triremes, yet the combat between the forces of united, or half united Greece, and Syracuse was, according to the minute account of Thucydides, a far more determined struggle than Antony put up in defence of his adored Cleopatra.

As in most of the decisive victories recorded by Plutarch, and the Greek writers, there was treachery among the vanquished, which strips the victors of the glory their valor excited from end to end of the then known world.

But battling on vessels moved by three banks of oars, the fighting was far more desperate and even deadly than with powder and ball, for the fighting men had to come hand-to-hand and settle the matter by individual constancy.

In this fight, fifty thousand of the Athenian Greeks were counted gladiators and when they struck out against the Syracusans, it was like the meeting of so many Sullivans seeking the "solar plexus."

CHAPTER X.

WORLD RUSHES RELIEF.—AMERICA IN FOREFRONT OF MERCY.—PRESIDENT'S MESSAGE TO CONGRESS.—\$800,000 APPROPRIATED BY U. S.—RELIEF SHIP SAILS.—OTHER NATIONS AID.

ALL the world hastened to send to Italy not only its sincerest messages of sympathy, but more substantial help in the way of money and supplies.

Governments and individuals vied in their grand charity.

In this the United States was far in the lead.

No sooner had the news of the catastrophe reached this country than the President sent this cablegram to the King:

"His Majesty, Vittorio-Emmanuele, Rome.

"With all my countrymen I am appalled by the dreadful calamity which has befallen your country. I offer my sincerest sympathy. American National Red Cross has issued appeal for contributions for the sufferers and notified me that they will immediately communicate with the Italian Red Cross.

"THEODORE ROOSEVELT."

The American National Red Cross sent a telegram over the signature of its president, William H. Taft, to the Italian Red Cross at Rome in the following language:

"The American Red Cross desires to tender to the Italian Red Cross its profound sympathy because of the terrible earthquake in Italy and Calabria. An appeal has been issued to the American Red Cross for contributions for the benefit of the sufferers."

But America did not stop there. This Presidential message to Congress followed:

"The appalling calamity which has befallen the people of Italy is followed by distress and suffering throughout a wide region among many thousands who have escaped with life, but whose shelter and food and means of living are destroyed. The ordinary machinery for supplying the

wants of civilized communities is paralyzed, and an exceptional emergency exists which demands that the obligations of humanity shall regard no limit of national lines.

"The immense debt of civilization to Italy, the warm and steadfast friendship between that country and our own, the affection for their native land felt by great numbers of good American citizens who are immigrants from Italy, the abundance with which God has blessed us in our safety—all these should prompt us to immediate and effective relief.

"Private generosity is responding nobly to the demand by contributions through the safe and efficient channel of the American Red Cross Society.

"Confident of your approval, I have ordered the Government supply ships Celtic and Culgoa to the scene of disaster, where, upon receiving the authority which I now ask of you, they will be able to dispense food, clothing and other supplies with which they are laden to the value of about \$300,000. The Celtic has already sailed and the Culgoa is at Port Said.

"Eight vessels of the returning battleship fleet are already under orders for Italian waters, and that Government has been asked if their services can be made useful.

BAILEY'S "NO" SURPRISES.

"I recommend that the Congress approve the application of supplies above indicated and further appropriate the sum of \$500,000 to be applied to the work of relief at the discretion of the Executive and with the consent of the Italian Government.

"I suggest that the law follow the form of that passed after the Mont Pelee disaster in 1902."

Immediately Senator Hale asked that the matter be referred to the Committee on Appropriations. The committee met and within half an hour reported a resolution for \$500,000 in money and authorizing the President to dispatch \$300,000 worth of provisions on the navy supply ships Celtic and Culgoa.

Surprise was manifested when the Texas Senator, Bailey's, "no"

broke the stillness of the chamber. Mr. Hale quickly had precedents for the action incorporated in the record.

"I am one of those Senators," said Mr. Bailey, "who do not believe that the Federal Government has power to spend the people's money in this way. If it could be shown by authority that it has the power, I should be among the first to advocate it. It is evident the Senator from Maine wishes to justify the action taken to-day by inserting in the Record the matter to which he referred, but I believe there is no argument so fallacious as the one from precedent when that argument is advanced under the stress of a terrible calamity such as this."

Meantime the House had passed a resolution appropriating \$800,000, but saying nothing about the use of the *Culgoa* and *Celtic*. As soon as it was read Senator Hale objected to it as not specific.

Senator Lodge suggested a conference with the House, but the House had adjourned.

"Well," said Hale, "there is nothing for us to do but accept the substitute."

And it was passed.

President Fallieres, of France, sent a telegram of condolence on the catastrophe to King Victor Emmanuel. Premier Clemenceau sent a similar message to the Italian Premier, while M. Pichon, the French Foreign Minister, communicated his sympathy to the Italian Minister of Foreign Affairs, Signor Tittoni.

U. S. SUPPLY SHIP SAILS.

The United States supply ship *Celtic*, which was to have met the returning battleship fleet with holiday cheer, sailed out of New York Harbor a few days later on an entirely different mission, but without changing a single item of her cargo. She sailed direct to Messina, to give a million and a half of navy rations to the earthquake sufferers.

The idea of changing the *Celtic* into a relief ship came to her commander, Harry McL. P. Hust. It met with the immediate approval of Rear Admiral Casper F. Goodrich, commandment of the New York Navy Yard, who promptly communicated with the department at Washington.

Red tape was cut out in a jiffy on the ground of humanity, necessary preparations were hurried at the yard, and the Celtic, with Christmas trees still lashed to the mast-heads—it had been designed to make the Celtic the Christmas ship for the fleet—sailed. Her supplies were not eaten by American sailors, but by suffering survivors of the Calabrian and Sicilian disaster.

In the face of the overwhelming need of the Italians, the department considered its own men second.

Just as our ships were the first to reach Kingston after the West Indian earthquake disaster, so the American naval flag on the Celtic was the first to bring actual food supplies to Messina from any country, even though we were 3,600 miles away.

LOADED WITH PROVISIONS.

Stored in the vast holds of the Celtic when she steamed out was the following:

Fresh beef, 275,000 pounds; mutton, 13,000 pounds; pork, 82,000 pounds; veal, 54,000 pounds; sausage, fresh, 34,000 pounds; pork sausage, 30,000 pounds; bologna sausage, 5,000 pounds; turkey, 20,000 pounds; lunch meat, 9,500 pounds; chipped beef, 6,000 pounds; fresh eggs, 150,000 dozens, an equivalent of 8,000 dozen more dehydrated; 75,000 pounds fresh potatoes, an equivalent of 200,000 pounds of dehydrated potatoes; fresh onions, 40,000 pounds; apples, 9,600 pounds; corned beef, tinned, 40,000 pounds; bacon, tinned, 35,000 pounds; smoked hams, 59,000 pounds; tinned ham, 10,000 pounds; lard, 25,000 pounds; salt pork, 20,000 pounds; salmon, tinned, 25,000 pounds; barley, 1,000 pounds; beans (pea), 7,000 gallons; beans (lima), 6,000 gallons; cornmeal, 5,000 pounds; corn starch, 2,000 pounds; flour, 500,000 pounds; hominy, 2,000 pounds; oatmeal, 2,000 pounds; rolled oats, 4,000 pounds; rice, 5,000 pounds; tapioca, 2,500 pounds; tinned peas, 25,000 pounds; tinned beans, 10,000 pounds; tinned lima beans, 5,000 pounds; tinned corn, 25,000 pounds; tomatoes, 68,000 pounds; dried apples, 4,500 pounds; dried peaches, 2,000 pounds; prunes, 8,000 pounds; raisins, 2,000 pounds; nuts, 2,500 pounds; apricots, tinned, 7,000 pounds; peaches, tinned, 50,000 pounds; pears, tinned, 35,000 pounds; butter, 71,000

pounds; baking powder, 1,500 pounds; coffee, 50,000 pounds; catsup, 600 gallons; cheese, 7,000 pounds; milk, evaporated, 10,000 pounds; milk, condensed, 40,000 pounds; macaroni, 4,000 pounds; saur kraut, 6,000 pounds; sugar, 100,000 pounds; salt, 25,000 pounds; syrup, 2,000 gallons; large quantities of dehydrated vegetables; supplies of soap, tobacco and naval stores, but not very large amounts of medical supplies.

But other nations were not to be left behind in the work of mercy. From every quarter of the globe came sympathy and stores.

BATTLESHIPS ON SCENE.

The British battleship Exmouth and the cruisers Euryalus and Minerva, commanded by Admiral Sir Asheton Curzon-Howe, hastily left Malta for Messina to render every assistance possible to the survivors of the disaster. The British cruiser Sutlej, which was on her way from Messina to that port, was intercepted by wireless telegraphy and sent back to Messina.

The Minister of Marine promptly ordered the French battleships Justice and Verite and three torpedo boat destroyers to proceed to Messina to succor the victims, and other nations rushed all available ships to the scene of the disaster.

Most helpful of all, the great American battleship fleet, with its 15,000 officers and men, on its cruise round the world, was ordered to steam with all possible haste to the scene of the disaster.

With the arrival of the American men-of-war Chicago and Yankton, the advance guard of that portion of the fleet detached for the purpose, the United States and British Consulates opened joint headquarters on the tennis grounds in the north end of Messina. Hospital tents and supplies of all kinds were taken ashore by bluejackets from the newly arrived ships. The gunboat Scorpion, which had been the first to arrive, was relieved and sailed for Constantinople.

Sailors from the Chicago and Yankton, assisted by hired laborers, attacked afresh the ruins of the American Consulate. They uncovered and removed the bodies of a man and woman who had been buried and crushed under piles of fallen material. The man was identified as a Sicilian named Filippe, who occupied a room on the third floor of the Con-

sulate. The woman's body could not be identified, but undoubtedly was one of several female servants sleeping on the same floor.

Some clothing, a hat and a coat identified as belonging to Mrs. Cheney were found in the ruins early in the search, but the bodies of the Consul and his wife were not discovered till long afterward. The ruins of the Consulate were piled high, and it proved most difficult work digging into the mass of stone and beams.

In various parts of the city a few bodies were removed from near the surface of the ruins by the American sailors, but there was no system of identification or enumeration. Numerous instances of extraordinary vitality are related among the victims who, even two weeks after the disaster were dug out of ruins alive. Three women and one man were taken out very much emaciated and suffering many bruises, yet alive after having been buried for twelve days.

Another extraordinary case was that of a woman and her two infants rescued. They had been buried under a collapsed house, but protected from being crushed to death by the shelter of some protecting beams. The woman had kept the children alive for eleven days by nursing them, but one of the infants died as soon as taken out.

Those surviving under ruins but pinned down into almost immovable positions by huge beams and boulders, often showed amazing vitality. One man dug out after long imprisonment without food or drink, under piles of debris, was put on a stretcher and carried to an American ship. When the bearers reached the dock the man rose from the stretcher and walked to a cabin on board the vessel.

DEATH STILL HARVESTING.

These were the exceptional cases, for the death rate among the injured was terribly high. Many died daily on the ships and in the ambulance trains. The authorities moved the injured to Naples, Palermo and even Genoa, where rest camps were established.

Wooden shacks were erected in the parks and piazas to accommodate 5,000 homeless Messinians and to shelter the soldiers on duty. The north end of town was not damaged so much as other sections, and many of the low buildings there are intact.

The electric light plant was patched up and was put in operation about ten days after the first earthquake, affording facilities for continuing work on the ruins without interruption. But the authorities were all at sea, without system or efficient direction. Thousands of soldiers were engaged only in patrolling dangerous streets and guarding property instead of helping in the work of rescue.

SURVIVORS DISTRACTED.

Hundreds of donkey carts were employed in removing merchandise from half-ruined stores and warehouses in the Via Garibaldi Marina. Survivors owning property or awaiting the removal of bodies of relatives from ruins refused to leave Messina, but hung around helpless and distracted from day to day. Soldiers guarded streets where there is danger from falling walls, and at each end could be seen groups of men and women silently gazing past the military cordon at the ruins of what was once their homes.

The scenes in the desolated cities during those terrible days that followed the catastrophe are vividly pictured by one of the officers of the American cruiser Yankton. He says:

"When we had passed Scylla and rounded Capo del Faro there opened upon us the panorama of destruction. Faro, Paradiso, and all the villages along the coast were in ruins. Then Messina came into sight. The sun was setting, and a lovely frame of violet hills, a tranquil dark sea, and a sky of emerald and gold surrounded the scene of the world's greatest tragedy.

"At first the extent of the disaster was not apparent, for some still standing white walls showed prettily against the dark background, and it was hard to believe that the city was destroyed. But soon we saw that nothing remained but tottering shells. All along the magnificent, curved sea front was ruin. Nothing broke the desolate line. Nothing had been spared.

"And then we entered the harbor and the most dreadful things of all became apparent to us. Messina was dead. Throughout the length of the Corso Vittorio Emanuele, which a few days ago had been an esplanade busy with traffic and gay with life and color, was silence—the silence

of the grave. Sometimes a few soldiers passed, and at one point there was a small crowd waiting for the distribution of food. The rest was death. That was the first impression.

"Night fell, and the only illumination was from lamps and the searchlights of many ships in the harbor. I was rowed ashore. The searchlight of an Italian warship played on a single spot, and to it the boatmen took me. It was where the troops had organized some sort of headquarters, and a little band of soldiers was sitting around a camp fire.

"They talked softly, as men do in the presence of death, and, in the brilliant light from the ship, it seemed that this was the only place alive in what had been a town of 100,000 inhabitants. This was my second impression.

"I walked the length of the Corso, and then I realized the full horror of what had befallen Messina. The largest city in Sicily had been smashed as a glass dish would be smashed if it were thrown upon a stone floor. That any of the inhabitants survived seems a miracle. That the most appalling estimates of the loss of life have not been exaggerations appears evident. To go into details is useless. It is ruin everywhere. The only thing I found intact was Montorsolis's beautiful fountain of Neptune.

MOTHER ALIVE; BABY DEAD.

"No real comparison between Messina and San Francisco is possible," adds the officer. "I was in San Francisco five days after the earthquake, and already wooden structures were being put up, work had begun on the tramway lines, and the main streets were crowded with cheerful, hopeful people. The residential portion of the city had been spared, and just across the bay was Oakland, to serve as a temporary place of business. The case of Messina was altogether different. Soon there will be nobody left but troops. A small settlement may be established, but Messina has disappeared."

"A woman was rescued at Reggio, nearly two weeks after the first great disaster. Beside her was the corpse of a child five months old. She had tried to protect the infant with her body, but the baby had been dead seven days, during all of which the mother lay unable to move beneath

the wreckage. An exactly similar occurrence was reported during the great earthquake of the eighteenth century.

"Another thrilling episode of those terrible days following was the rescue of two survivors of Messina. One was a woman so exhausted that she succumbed. The other was a two-year-old baby, so bright and lively that it seemed to have come from the comfortable warmth of a cradle.

"The horror was greater than any one who did not see it can imagine. To walk along the quays and avenues, in the square and gardens, was to walk among massive ruins and through one great charnel house of large palaces, offices, public buildings, the cathedral, and churches. There was nothing but rubbish heaps, piles of dust, bricks, and splinters three stories high, from which one could pick up here a silver tray, there a lady's lace scarf, again a box of men's collars, books, diaries, photographs, picture postcards, or statues and curios.

"Many of the walls stood as mere shells, and inside were mountains of debris. From some windows still hung curtains. Here the floor collapsed with the bed. There pictures were still on the wall and all the rest splinters and dust.

STREET LIKE A DESERT.

"But all that was mere material destruction. The real horror was indescribably worse. The mere physical fact of the odor that entered the nostrils on landing was terrible. Then the processions of troopers bearing shapeless bundles on stretchers—endless processions. From some of these burdens a charred hand or foot emerged. In others one discerned under the clothes the profile of a face or the outline of a form. Stretcher after stretcher went by.

"A few steps further on one found bodies laid at street corners and left unwatched. Then more of such open-air charnel houses at every turn. Here were dozens of corpses in a row; there fifty; further on perhaps a hundred, and close by the survivors—hundreds around a fire.

"Camps were rigged up everywhere and scores of children are playing a few steps from those terrible wrapped-up bundles. Tents and wooden huts were put up in avenues and squares for the survivors. Some were in disabled cabs, some under mere stretchers of rags.

"I went up a number of alleys, streets, and arcades where the way was passable. Others were blocked up stories high with debris all around. The arcades, from the Conservatorio Emmanuele to the Via Garibaldi, were bare and black with smoke. The municipal palace was still burning furiously inside. The British Consulate was outwardly little damaged, but inside completely wrecked. Over it flew the flag untouched.

"Many arches were still intact, but the shops were a mass of wreckage—jewelers' shops, art studios, banks and milliners' shops were full of rubbish. Near by the Trinacria Hotel was razed with English and German visitors still beneath the ruins.

"The large Via San Martino was a desert. The frontage of the houses was little damaged; inside nothing but a mass of rubbish. Across the road a row of dozen corpses, and close by survivors and troopers camped around great wood fires.

ALL ALIKE; POOR NOW.

"At the other end of the town were larger camps. The Piazza della Porta-Bassa was crowded with tents. Mothers nursed their babes by gypsy fires on which rations cooked while the children played about unheeding, all clad in strange and many-colored odd garments. Rich and poor mingled and one could not tell who in the crowd was a rich Sicilian noble and who a beggar. All are alike poor now. Yet there were many of them who were extraordinarily uncomplaining. They seem resigned. They may be stricken dumb and dazed.

"Across the Corso by the seaboard the colony under the tents was more loudly tragic. An old woman wounded lay shrieking incessantly. I passed her tent six times and she was still shrieking, with her husband prostrate by her side. Along the road wooden huts harbored families in extraordinary rags—some brilliant, some filthy. In a railed-off park bread was being given out as quickly as possible by troopers, and a heart-rending, hungry mob crushed against the bars shouting, whining, and moaning for bread like wild animals at feeding time."

One of the saddest scenes America saw in connection with the disaster was witnessed in New York when four hundred Sicilian steerage

passengers on the steamship *Germania*, which arrived a week later from Naples, were stricken with grief when they learned for the first time of the disaster which had befallen their relatives and friends in Messina.

Not a word of the earthquake had reached them until the steamship reached her dock, when a reporter boarded the vessel and through an interpreter broke the news to them. At first they were inclined to be incredulous and seemed not to realize that any of them were concerned until one of the passengers from Messina asked whether the earthquake had damaged that city.

"Messina is wiped out," replied the interpreter.

"My whole family is there," shrieked the passenger. "My poor wife and children; they are all dead."

The heart-broken Sicilian threw himself on the deck, and though his fellow passengers crowded around and endeavored to comfort him he continued to bewail his fate.

Others thronged about the interpreter and questioned him frantically about the disaster, and as each new detail showing the great loss of life was related those coming from the earthquake region wept and wrung their hands or ran shrieking about the deck.

So distressing did the scene become that the captain ordered the interpreter to discontinue his tale until the Sicilians had left the ship.

Many of the passengers declared that they would return to Sicily at once, but were dissuaded when they were informed that the dead would have been buried long before they could reach their homes.

CHAPTER XI.

THE STRICKEN REGION.—THE PATH OF THE RUIN.—SHAKEN AGAIN AND AGAIN.—PRIZE TOO OFTEN DEATH.—MAGNITUDE OF DISASTER.—QUAKES PERIODICALLY IN SICILY AND CALABRIA.

THE stricken region is something the shape of New Jersey, but it is larger; it was more populous. We may figure Messina as Paterson, a town about its size; every building is a ruin, every street a plague spot, the army in control, the refugees being removed to Pittsburg. Jersey City is scarcely larger than Catania, where the tidal wave smashed every small boat and half ruined all the town below the heights. Caltanissetta, the sulphur capital, is as large as Elmira; and a thousand dead lie there. In the seventy-mile circuit about Edna lie Giarre, Acireale, Paterno, Bronte, the town of Lord Nelson's title; Aderno and Belpasso, with 120,000 people. A population like that of Newark and the Oranges lies here in the perpetual power of Etna; we do not yet know how they have fared.

In the north it is the soil that yields harvests; in the south, the sun. We can form no concept of the extent of the terror without remembering the exceeding density of population wherever the cultivable shores invite industry. The railroad running from Messina to Catania is like that from New York to New Haven in the number and size of the towns and villages.

Imagine along all that distance a tidal wave of more than thirty feet, piled higher by resisting obstacles, and following an earthquake like San Francisco' The colder Calabrian coast facing the northwest is not quite so populous, but even there the earthquake found no lack of victims.

In a little time the world outside will turn to other topics more near, to it more pressing. We wonder at nothing long. But sine steam and the cable knit all nations closer together the brotherhood of man is better understood. It is only known that the earthquake is the greatest disaster of historic time; it is certain that no other has ever so appealed to the sympathy and the generosity of the whole world.

From the Sicilian mountains to the west of flaming Etna, Italy's broad road of immemorial ruin runs northeastward to Cotrone, on the Adriatic Sea. It is the path that the worst earthquakes have taken for the past thirty centuries. It is the path chosen by the great disaster of December 28, 1908.

Further back than written history goes the legends run telling tales of destruction wrought by the wrath of the heathen gods. Before the birth of Christ, so the dwellers in this smiling but treacherous landscape believed, it was here that was fought the tremendous battle between Jupiter and the giants for the conquest of Heaven itself. Enceladus, the leader of the conquered giants, was laid prostrate and Mount Etna was piled upon him.

Even to this day some of the more ignorant of the survivors of the latest disaster believe that the earthquake is this ancient giant stirring in his pain, struggling to free himself from his bonds and to arise, and that the flames that made lurid the skies were his fiery breath.

Probably this myth had its origin in some such appalling disaster as the one that on that December night in 1908 laid waste once more the south of Italy and the east of Sicily.

SHAKEN AGAIN AND AGAIN.

In later times Calabria—the province that makes the foot and the ankle of Italy's "boot"—and Sicily have been shaken again and again by earthquakes, causing the death of unnumbered thousands.

Yet the land lies desolate but a little while, as time is measured by history. In a few years it smiles again with fruit and oil and wine, and then, when the living generations long have ceased to remember the dread tales of those that are gone the earth trembles again and this broad road of ruin once more is strewn with the bodies of the dead, whose only monuments are the stones of ruined cities piled above them.

The Italian clings to the traditions of his ancestors with greater tenacity, perhaps, than any other race.

Since history began to be written men have dwelt on the slopes of the volcanoes of Etna and Vesuvius, though knowing that any moment they might be overwhelmed by fire or lava or ashes. It is the ashes, in-

deed, that the volcano casts forth that are the irresistible temptation for the Italian agriculturist. They are the finest and cheapest fertilizer known.

This is a temptation indeed, but at best its prize is a bare existence, while the penalty is, all too frequently, death.

When Mount Etna scatters them far and wide farmers rejoice, for that means that the crops will be abundant. In no place do the groves of oranges and lemons and olives flourish as they do under the volcano's shadow, and nowhere else is their chance of life so small.

The finest oranges in the world come from the groves on the shoulders of Etna. Some of these lands, continually menaced by earthquake and flame have escaped destruction from the floods of molten lava and have been cultivated for centuries without other fertilization than has come from the ashes blown down from the crater far above, and they are as productive as they were 2,000 years ago.

But all this region of fertility and plenty in Sicily and Calabria is a deserted waste now along the broad path which the earthquakes have scarred time and again through the centuries. Of the nearly two million people who lived in the whole region a tenth, perhaps more, perished.

Detail slowly added to detail, horror upon horror's head, no longer permit doubt that the earthquake was the most appalling disaster of modern times. The estimates of loss vary up to 250,000, whom Prof. Rioco, director of the Etna Observatory, believes to have perished. The number will never be positively known. Perhaps the larger estimates are the more accurate.

MAGNITUDE OF DISASTER.

At San Francisco fewer than a thousand dead; in the pounding maelstrom of the Johnstown flood less than three thousand. These disasters shook the nation from end to end; conceive what must have been the feeling in Italy, especially in Southern Italy, familiar now with the sight of refugees, famished, wounded and bereaved!

Messina lost 40,000 from plague in 1740, 16,000 from cholera so recently as 1856; such times of death and panic are far surpassed now in

that town alone. More than once in modern times famine has destroyed its million people in India, but their pitifully dragging deaths lack the dramatic shock of earthquake. And then—they were so far away, so little bound to us by ties of blood, so apathetic even to each other's sufferings!

Mont Pelee did its work six years earlier with awful thoroughness, but within a little space comparatively. The wreck of Herculaneum and Pompeii was not in loss of life a great calamity. The earthquake that engulfed Lisbon was far less destructive, and for a horror to cap that we must go back more than two hundred years.

The great Calabrian earthquake of 1783, which stands out in the history of that oft-stricken country with horrid distinctness because of the completeness and accuracy of the reports which have been handed down, is credited with having killed 30,000.

QUAKES PERIODICAL IN REGION.

Earthquake and disaster have been periodical in Calabria and Sicily so long as the memory of man runs, and while the early traditional statements of the loss of life and property were doubtless exaggerated, the ascertained facts of history are sombre enough.

Less than half a century ago a careful observer made the estimate that in the Kingdom of Naples alone in the three-quarters of a century previous the annual toll taken by earthquakes was 1500 lives, and in the period since that date the disasters have been repeated and severe.

Wholesale emigration has not helped the situation, and the constantly recurring famine and pestilence in the train of the earthquakes have helped to make these provinces the most beautiful in Italy, and full of priceless historic association, the most backward in the kingdom.

What will be its future? Who shall say?

I have seen the peasants on the slopes of Vesuvius, laying the foundations of houses to replace their overwhelmed homes while the lava beneath their feet was still too hot to be touched with the naked hand.

Dig a foot down and it is a molten mass, red with the heat of nature's furnaces. Yet with desolation and destruction all around him, the peasant nonchalantly goes on with his owrk.

"It is fate," he mutters. "If God is to strike, he can strike elsewhere as well as here."

That is his philosophy. That is his impulse to-day founded on the history of the past.

Messina may never rise from its ruins. Reggio's bones may bleach to the sun of the centuries. Who can say?

The money or material loss in the earthquake district was calculated in terms of hundreds of millions of dollars. When it is considered that this blow fell upon a very small area and a relatively few people, the utter devastation following in the wake of the disaster appalls the imagination.

A destructive earthquake such as this, accompanied by a tidal wave, appears to remove the very foundation of the people's property and sustenance.

In San Francisco fires and West Indian hurricanes something is left to the survivors. Houses are torn to pieces, many people are wounded and killed, the property damage is great, but the sun shines for the survivors, food is within reach, hope is left.

CAN RECONSTRUCTION COME?

In the wake of the Italian earthquake the means of life were swallowed up at one stroke, and there remained only desolation complete and staggering.

One of the brightest aspects of this terrible calamity was the exhibition of the spirit of pity, mercy and helpfulness which animated the world. In this splendid rivalry the United States was in the forefront, and one nation spoke to another.

A century and a quarter ago all Calabria trembled for one awful moment. When the earth grew still again 50,000 lay dead. Fifty-two years later occurred a comparatively minor disaster, and but a thousand were killed. In 1857 Calabria lost 10,000 inhabitants by another earthquake.

In Sicily, in 1783, the same tremor that shook Calabria nearly destroyed Messina and killed 60,000 of its inhabitants, besides causing great

loss of life and damage to property throughout the eastern part of the island.

In 1894 and in 1906 there were other similar disasters, though on a less appalling scale.

The various scourges of the earthquakes can be traced chronologically all along this broad highway of destruction with fair accuracy by one familiar with architecture.

In an ancient town like Messina, for instance, the antiquarian's and archaeologist's eye can read the date of the earthquake's autograph everywhere.

It is the custom in Messina, as elsewhere throughout seismic Italy, for the inhabitants to rebuild the ruined structures in the style of architecture in vogue at the time of their destruction.

Therefore, scattered all over the older part of Messina are bits of ruins illustrating the architectural fashions of every one of its epochs of prosperity in the twenty-seven centuries of its life. In the other cities of Sicily and Calabria it is the same.

HOUSES MASSIVELY BUILT.

But even though every rebuilding marks a change in architecture, in the outward lines of the structures, yet their general principles of construction remain the same, and every feature that has caused the death of thousands in the past when the earth has rocked is retained religiously.

From time immemorial the houses have been built of stone—massive, it is true. But an earthquake such as that of 1908 would tumble the Pyramids themselves into the dust.

Past disasters seem to be forgotten by the time the stricken cities begin to rise again, and little if any effort appears to be made to take advantage of the lessons taught by past disasters.

Great stone cornices top the walls, broad gutters of heavy stone overhang the eaves of the houses to catch the infrequent rains.

When the earthquake comes these things are the first to fall, and even if safety is sought in the usual havens of refuge—beneath the arches of the buildings—these great masses of stone falling from a considerable

height and sending their pieces flying in every direction cause many to perish.

In Japan, which is a more highly seismic country than Italy and whose climate is much the same as that part of the latter country that is subject to earthquakes, the houses are mostly of bamboo, and of the lightest description.

When the earth rocks there, even if the bamboo dwellings do fall, the inhabitants crawl out of them quite unhurt, and the loss of life and property is small. It is rare to hear of many perishing from an earthquake in Japan, unless it be accompanied by a tidal wave.

JAPAN'S GREATEST ADVANTAGE.

But while bamboo is cheap and available in Japan, neither that nor wood of any description exists in abundance in Italy. It is a country comparatively denuded of its forests.

Those that are preserved are jealously guarded, and wood is costly. Even the "box shooks"—as the thin strips of lumber from which the boxes in which lemons are shipped are called—are sent from this country.

Stone, on the other hand, is plentiful and cheap. Therefore, every building is of stone, some a little more massive than others, according to the wealth of the owner.

But even the structure with the thickest walls will fall apart when the earth rises and falls like the sea.

The cities of Central and South America, where violent shocks are felt occasionally, are built almost entirely from concrete, which makes an entire edifice one homogeneous mass, just as if it were carved from one solid block of stone. These withstand the impact of the jolting earth far better than structures where stones are piled one above the other.

Yet, strangely enough, in southern Italy, in the very country where cement was invented by the Romans, but few of these concrete buildings are to be found to-day.

Most of the examples of concrete construction are bridges and arches built by the Romans themselves from ten to twenty centuries ago. These, despite a little outward crumbling at the corners and surface cracks, are as strong as if they were put up within the last decade.

The long procession of earthquakes seems to have passed them by without touching them with a destroying hand.

In other ways, too, progress has stood still in this earthquake land. Even the largest cities that have sewerage systems at all possess those that are far behind the standard set by the sanitary engineers of other places of similar size.

In the larger towns the ancient system of cesspools is in common use, and in the smaller the centuries-old custom of letting the sewage flow into a gutter in the centre of the street and thence to some spot on a lower level where it may enrich the ground is in use.

REBUILDING UNLIKELY.

Many of the ruined cities never will be rebuilt, in all probability.

Reggio, for example, a town of 50,000 inhabitants, of whom but few escaped alive, doubtless will disappear from the map.

Messina, a town of 150,000, in the storm centre of the earthquake, though it has lasted for 2,700 years, may never recover fully from the present disaster.

An important factor in reconstruction is likely to be lacking when the country tries to adjust itself from this terrible shock.

A large part of the population will emigrate as quickly as possible to America, leaving but few to carry on the work of rebuilding the shattered cities and reclaiming the devastated fields and vineyards and groves.

That will mean that during the few years hundreds of thousands of the peasants from the Calabrian mountains, Sicilians from the slopes of Etna—men of all occupations in life—will set sail for North and South America.

This country is sure to get the full of the emigration—in fact, New York will get such an influx of Italians as it never had before.

It is possible, in addition to the sum given to the earthquake victims, that another vast fund will be raised in this country for the bringing of this great army hither.

But the amount of this fund never will be known, for it will flow over to Italy in little dribbles from the millions of Italians here who have friends and relatives over there.

The scientists are beginning already to disagree about the causes of this great earthquake.

One group of seismologists contends that it was caused by a leakage of water through the bed of the ocean, through the earth's crust, in fact, until it reached the subterranean fires that feed the volcanoes.

Even when it is considered that the thickness of the earth's crust is fifteen or twenty miles, scientists of this school claim that this theory is entirely reasonable, and point out the length of time during which the water sweeps through the rocks and stores itself in some vast chamber in the earth, finally to be turned to steam by the unquenchable fires beneath.

Then the terrific force of the imprisoned vapor finally reaches the point where it has to burst forth and it shakes the earth.

Another group, equally eminent, is quite as positive that the sliding and shifting of the earth's crust bring about the disturbance. But while there is much speculation about the cause of earthquakes, no man has been bold enough yet to advance any theory as to how they may be prevented.

Whatever the cause, the result in this recent disaster has been to materially change the geographical features of southern Italy and of Sicily.

CHAPTER XII.

SCIENTISTS DISCUSS DISASTER.—HEAT AT EARTH'S CENTRE.—EARTH PRESSURE RIGID.—DISTRIBUTION OF STRESS.—TEN MILES OF ROCK.—PROFESSOR HILL'S THEORY.—EARTH A LIVING MECHANISM.—PHENOMENA OF THE PRESENT.

THE recent appalling disaster in Southern Italy—one of the greatest disasters that has ever befallen the earth—in which entire cities and villages were swallowed up by earth and sea, and hundreds of thousands of lives were lost, has created a worldwide inquiry into the present physical condition of the earth we live on.

A man need not be a cynic to ask, "Is this earth a safe place of abode?" Apparently not in certain spots.

With volcanic eruptions, earthquakes and tidal waves occurring in some places, what is to prevent similar unexpected outbreaks in others? Nothing at all, under similar geographical conditions.

These and many other questions and answers have probably arisen in the mind of every speculative man and woman since the dawn of the new year, when the full extent and horror of the Italian disaster began to be fully realized. And it is scarcely to be expected that very much consolation will be derived therefrom, or even from the statements of some scientists regarding this earth's internal troubles, their alarming causes and probable disastrous results.

It is not very comforting, for instance, to be solemnly informed that we are living to-day on the outer shell of a high pressure boiler, which leaks badly in certain weak spots and "blows out" with alarming frequency, along a certain weak plate which is geographically known as the "earthquake belt."

If you take a map of the world and draw a broad line straight across the Pacific Ocean, from the Philippine Islands to Panama, thence across the Atlantic Ocean through the British West Indies to Spain and Italy, thence continuing across Europe and Asia to Japan, and on to the start-

ing point in the Philippines, you will see exactly where the earthquake belt lies.

There are other minor belts, one of which passes southward along the coast of California and Mexico and the west coast of South America. There are evidences observable to-day in practically all parts of the world of other earthquake belts in which tremendous geological changes and upheavals were wrought in prehistoric times.

Even New York City is in an earthquake belt. At some time, probably thousands and thousands of years ago, a might earthquake split asunder the rock that united what is now the island of Manhattan to the Palisades of the New Jersey coast. That earthquake formed the Hudson River.

Earthquake belts are admittedly weak spots in the outer crust of the earth—the high pressure boiler on which we live—and there is no evidence that any of them were ever permanently repaired.

SAFE FOR A TIME, ANYHOW.

Professor Edward Seuss, the eminent Vienna geologist, predicted a few days ago that eruptions would follow earthquake and tidal wave in Southern Italy. He attributes the earthquake to the sinking of the earth's crust, otherwise a buckling of the boiler plates, in the zone of which the Lipari Islands are the centre. He declared that as the process of sinking went on the Calabrian and Sicilian highlands on either side of the Straits of Messina would be submerged, only the highest peaks remaining above the sea. The strait, he said, would thereby be greatly widened.

Professor Suess is of the opinion that the earth's crust is gradually shrinking everywhere. There is consolation to be found, however, in his further remark that the life of the human species will be too short to make this phenomenon important to mankind.

The average thickness of the earth's crust, the boiler plates, is generally assumed to be fifty miles and its average density to be about five times that of water. Scientists have estimated that the downward pressure at a depth of fifty miles below the surface of the earth is somewhat in excess of half a million pounds to the square inch. It is a safe conclusion that within a large portion of the earth's crust there exist pent-up

gases, particularly steam under a pressure equal to that exerted by the most powerful high explosives. High explosives probably exert pressures ranging from 200,000 to 350,000 pounds to the square inch.

When a high explosive is detonated the amount of pressure depends upon the volume of gases liberated and the temperature of the gases. Nitroglycerine, exploded in a space where it could not expand, would exert a pressure of probably from 300,000 to 350,000 pounds to the square inch. The pressure would certainly be less than half a million pounds to the square inch, although the temperature of the gases would equal the boiling point of steel. Consequently, with a 500,000 pound force holding in check a 350,000 pound force which is continuously exerting itself in an effort to burst the earth's crust asunder, it is reasonably safe to assume that the stronger force will continue to prevail, for some time to come at least, and that there is not the slightest danger of the earth blowing to pieces.

WEAK SPOTS IN EARTH'S CRUST

Unfortunately, as the appalling record of earthquakes shows, there are many very weak spots in the earth's crust. Deep down under the crust, where water has entered through faults, to be entrapped and highly heated, with no room for expansion, it dissolves the rock, and as under the enormous pressures it forces its way through narrow crevices to new positions it cuts new channels in the granite floors, just as in glacial time subglacial streams cut passages through the ice.

Consequently, when the eruption of a volcano takes place, relieving the pressures in the deep passages under it, there is a rush toward the outlet of streams of superheated water made syrupy with stone in solution. As these streams of silica-charged water find vent at the volcano the expansion of the pent-up stream takes place with explosive violence, forming volcanic dust and pumice stone, which are belched forth in stupendous quantities. Then portions of the earth's crust, which have been resting upon a support of steam under dynamite pressures, naturally sag and shift when those pressures are removed or materially lessened.

The vast amount of solid matter ejected at times from volcanoes is difficult of comprehension. The great volcano Krakatoa had been ex-

tinct for ages when, in 1883, its top blew off with a shock felt clear through the earth, and with a blast that sent a wave of air around the earth three times, while the fine volcanic dust did not entirely settle out of the atmosphere for more than two years, as was indicated by the unusually brilliant display of red sunsets. It is estimated that more mud was ejected from the mountain on that occasion than the Mississippi River discharges in two hundred and fifty years. This was the greatest volcanic eruption in historic times. The distance is not too great nor the time too remote for the eruption of Mont Pelee to have caused the earthquakes of San Francisco, Valparaiso and Kingston, while possibly Vesuvius may have played a material part.

EARTHQUAKES TO CONTINUE.

In the opinion of the astronomical editor of the Almanach Hachette, earthquakes will never cease until the shell, or crust, of the earth rests upon a completely solidified block. The earth will then be in a form which only exterior forces can modify. But at this distant and fantastic epoch the sun will no longer send us heat, and the earth, like the moon, will have become a wandering sepulchre in the vast abysses of space, without atmosphere.

For the benefit of any who may be anxious to find some place on this high-pressure boiler beyond reach of earthquakes and volcanoes, attention is directed to a statement recently made by Professor T. J. J. See, in charge of the naval observatory at Mare Island, Cal., and professor of mathematics in the navy.

"There are a considerable number of earthquakes which occur inland," said Professor See, "but it is found that they all occur in regions of abundant underground or meteoric water, while none at all occur in the great inland deserts. The great deserts, like Sahara, are the only regions on the earth wholly free from the danger of earthquakes, though in many places where the sea is shallow and the rocks are little broken the leakage is very gradual, and no severe shocks occur.

"This is true for Northern Europe and the eastern part of the United States, for example, and both of these regions are comparatively free from earthquakes. In deep seas, where the pressure is great, as along the

west coast of South America, east of Japan, near Sumatra and Java in the East Indies and elsewhere, the formation of steam under the earth's crust accumulates rapidly and the coasts are continually shaken by violent earthquakes, which originate generally under the deep troughs of the adjacent seas. This shows the nature of the cause at work.

"When the steam pressure has become great enough a shock occurs, and some relief is afforded until greater pressure develops and the phenomenon is renewed. When the great world-shocking earthquakes occur, of which there are more than sixty each year, lava is often expelled from under the sea and the land more or less elevated. Sometimes new islands are upheaved in the same way.

"There are about four hundred active volcanoes on islands and about the margins of the oceans. Numerous eruptions occur beneath the sea, but none at all inland at distances exceeding about one hundred miles from oceans or equivalent large bodies of water.

EARTH CANNOT BLOW UP.

Hudson Maxim, however, gave an added note of reassurance when he said:

"The theory is frequently advanced that planets, and even suns, sometimes explode, and that the earth may some day blow up like a bombshell. No celestial body the size of the earth could possibly explode.

"If the entire molten interior of our globe could be replaced with nitroglycerine and detonated, the explosion would not lift the earth's crust. In other words, if we assume that the crust of the earth is from fifty to one hundred miles in thickness, it would require something much more powerful than even nitroglycerine to burst the shell.

"It is necessary only to do a little figuring to see that the pressure of the earth's crust at a depth of from fifty to a hundred miles far exceeds the pressure exerted by the most powerful high explosive."

"While the disaster in the south of Italy, from a human standpoint, is appalling," said Prof. William Hallock, of Columbia University, "probably the most awful catastrophe in man's history of man, it cannot be regarded as so important an indication of the earth's scientific vagaries

as the quake in San Francisco. The disturbance on the Pacific coast extended for an area of over 200 miles, while the actual place of disturbance in Italy was very much smaller.

"Of course, to the minds of the superstitious and the scientifically disinterested, there is in an earthquake an extraordinary element of unknown horror, of an impending disaster that lies under our feet, over which we have no control, no forecast, and no means of protection. It comes suddenly and in a few seconds, perhaps, destroys hundreds of thousands of human beings.

"The actual mystery of the earthquake is only partially explained in scientific research, that, by deductive theories, only manages to pacify our awe of the unknown.

"There are things we know about the interior of the earth, and many things we don't know, but would like to. We are ourselves merely on the crust of the earth, which scientists have variously estimated to be from ten to fifty miles below us. From the inner edge of this crust to the centre there are, presumably, gaseous matter substances of excessive heat.

HEAT AT EARTH'S CENTRE.

"The temperature of the centre of the earth, which has been sensationally declared to be 'inconceivable' by Flammarion and others, is probably not so at all.

"Calculating a conception of these inner temperatures of the earth by the increasing heat that miners find as they descend deeper and deeper into it, it may be assumed that the probable temperature of the centre of the earth is about equal to that of an arc light or an electric furnace, which is about 5000 to 6000 degrees Fahrenheit.

"We have a fair precedent for this theory in the temperatures taken in the Yellow Jacket Mine, in Michigan, which is, perhaps, the deepest hole that has been made in the earth, extending a little over a mile from the surface toward the centre.

"In the deepest part of this mine the temperatures, which are not much worse than the heat of a summer day in Arizona, represent about one-four-thousandth of the entire distance from the surface of the earth

to its centre. If the increase in temperature occurs in the same ratio as our observation of it in mines has shown, then we may assume that there is in the centre of the earth a gaseous liquid that has the extreme heat of an electric furnace.

"So far it seemed that what we most feared was scientifically indorsed, namely, that the earth was a shell filled with explosive gases that might blow us all to kingdom come at any time. This was not a scientific fact, however, but merely a theory of modern sensationalists.

"The idea that this liquid gaseous material in the centre of the earth resembles a vast volume of air, in a toy balloon, for instance," said Professor Hallock, "is not scientifically accepted.

"The entire earth is pressure rigid.

"It is subject to differences of load caused by the shifting of that load. It is the incessant readjustment of balances in the integral rigidity of the earthsphere that causes earthquakes.

EARTH PRESSURE RIGID.

"Imagine the tons upon tons that are carried from the mountains to the sea by the rivers!

"The Mississippi River alone probably bears continuously millions of tons from the mountains to the ocean.

"Necessarily a pressure taken from one place and increased in another too suddenly causes a cave-in, or releases a pressure from below, which makes the upheavals we call earthquakes.

"It is an accepted theory in the scientific examination of the earth's substance that it is as nearly pressure solid as it can be, but not wholly so, a conclusion that leads us to believe that the adjustments of pressures is becoming steadier as the years progress.

"The laws of nature, that are full of surprises to the student as long as he has life to pursue them, however, have a tendency to accomplish these physical readjustments with an almost imperceptible balance.

"The centre of the earth, being a supremely heated conglomeration of molten matter, is an impending upward pressure, kept in check by a pressure of matter from above, as evenly as the marvels of natural law

will permit. Usually the pressure of these upper layers of earth keeps it from a melting process.

"A pan of paraffin, for instance, when frozen over, causes an even layer of thin solid matter on the top surface without any visible displacement or diminution. That top surface is susceptible to the pressure of an additional load placed upon it.

"If this new load is adjusted evenly it will make no crack or breakage in the frozen surface; it will merely mix with the paraffin below, without any sudden physical activity. But if the new load is put upon the frozen surface of the paraffin unevenly it will create a visible cracking and upheaval in the pan.

"So the pressures of the earth's surface, above and below, which are usually adjusted with a marvelously even distribution of the load, prevents upheavals, or, as the load is shifted suddenly from above, or from some place far below the crust of the earth, an upheaval occurs such as the Italian catastrophe has shown us.

"The weight of the mountains of the earth, whose topmost peaks may be below the level of the sea, or thousands of feet above the valley, are geological indications of prehistoric earthquakes. Fossils have been found in mountains. It is possible that these mountains were made suddenly in a titanic upheaval of the earth that lifted them out of the bottom of the sea 'in the twinkling of an eye.'

TEN MILES OF ROCK.

"Who knows why it is hotter in the centre of the earth than on the surface?

"There is a theory that this chemical mystery in the bowels of the earth is caused by radio activity. I don't know.

"Then there is a theory that the coast lines of the earth are more susceptible to earth upheavals than places remote from the sea. This theory is not fully sustained, because we have innumerable indications of earth tremors and oscillations in the interior of the land.

"We know by calculations that the Jersey shore is settling; in the State of Massachusetts there are perhaps 200 earth shocks of a slight nature a year.

"The surface of the earth can be compared to the top of a barrel of asphalt, hard and rigid through and through, seamed and cracked on the surface by the elements.

"For ten miles in a straight line below the surface the earth is probably dry and hard, of a rock substance. The pressure of this substance upon the heated center of the earth keeps it from getting hotter than it is, just as you can keep water from boiling by an appropriately sufficient pressure. The fact that there is steam in volcanic eruptions is the leakage of the interior pressure of heat in the earth.

"The character of matter in the center of the earth or its immediate environment must be something like pumicestone, porous, light, because when the earth's interior matter is melted in the high temperatures that are there it dissolves and there is considerable water in it that escapes through volcanic craters in steam.

"Volcanoes and earthquakes, though undoubtedly related, are not inimical to one another, and are not alike. This is shown in the fact that destructive earthquakes may occur, and have occurred, in regions quite remote from volcanic eruption.

KNOWLEDGE THEORETICAL.

"The lava that streams from the crater of a volcano is a sudden release of the inner boiling liquids of the centre of the earth that in their transition from their origin to the atmosphere undergo innumerable stages of chemical change and evolution, causing the various strata of mineral quality that geology is continually uncovering.

"The passage of these interior liquids of the centre of the earth may be tortuous, frequently caught in the overarching pockets that the earth causes in its readjusting upheavals, and remaining there for years, slowly working out a chemical activity for its own release.

"The deeper one penetrates into the causes of the internal mystery of the earth, the more obviously theoretical is our knowledge.

"I do not believe there is any relationship between sun spots and earthquakes; the elements and celestial influences are not concerned in the inner activities of the earth.

"The temperature of heat in the centre of the earth which was di-

rectly involved in the earthquake in Sicily was not higher than that of the temperature of an arc light, which is by no means inmonceivable. The surrounding pressures immediately controlling the heated liquids of its centre keeps that liquid substance more or less hard, which constitutes our belief that the earth is pressure rigid.

"There is no doubt that earthquakes are diminishing. This is easily shown by comparing the history of the world's earthquakes as we know them according to the rapidity of geological changes.

"The displacement shown by the cracks in the San Francisco earthquake were only a few feet.

"Geological observation of prehistoric earthquakes shows that the earth made fissures and slides of 20,000 feet. Take the evidence in geological survey of Mount Shasta, in California, and the probable South American catastrophes of prehistoric time.

"But there is no actual scientific assurance of the breadth and immensity of these gigantic upheavals. We are still in a state of theoretical conclusion about earthquakes. Actually our knowledge is comparatively limited; there is no possible forecast of earthquakes. The seismograph merely registers a disturbance when it is occurring.

"Of course, the human comprehension of an earthquake phenomena is as primitive and terrifying as thunder and lightning was once a fearful demonstration to primitive races.

PEOPLE ARE INDIFFERENT.

"People continue to live on the sides of volcanoes, in the valleys of eruptive zones, with naive indifference to the danger about them. They learn no lesson in these disasters. The region in which this Italian earthquake disaster occurred, although well known to be in the earthquake zone, had apparently quieted down.

"We associate earthquakes with eruptive neighborhoods. If the recent upheaval of the earth had taken place in the South Sea Islands the world would not have been so shocked. Of course, the appalling loss of life in the city of Messina was due to the fact that the houses were built of stucco and stone. In San Francisco the greater part of the houses were frame buildings of redwood.

"Another cause of destruction was the tidal wave.

"It takes a comparatively small upheaval of the bottom of the ocean to make a huge and destructive tidal wave. An upheaval that would make a hole in the sea bottom of forty or fifty feet would be enough to produce a tidal wave twenty or thirty feet high.

"So far as we can conceive, with the help of scientific precedent and geological observation, there are sections of the earth that have apparently become immune to earthquakes, but there is no assurance of the matter. The disaster in Sicily was probably local, and could have no forecast in it of similar disaster in any distance directly in line but away from it.

"Our observatory at Columbia is in direct latitude with an observatory in Naples, but there is no connection between longitudinal or latitudinal lines around about the earth with earthquakes.

"In its scientific character the disaster in Italy is not so startling or important as the earthquake in San Francisco, but its aspect of human catastrophe has probably never been equalled in the history of man."

ANOTHER SCIENTIST THEORIZES.

"There are so many superficial reasons given for the cause of earthquakes," said Professor Robert T. Hill, "that considering their apparently authentic sources are surprising.

"Earthquakes, as terrible as they may seem when they destroy a few thousand human beings, are but one of the many manifestations which we have of the world at work, and their full significance is only comprehensible to one who has eliminated from his mind the idea that we are living upon a dead and finished planet.

"That is not only an old theory, but according to all the significant indications of intelligent science utterly untrue. The earth is not a dead planet, and very far from being a dying one. Its activity is eternal, its physical vitality is as restless and eager as the life of a growing child.

"The earth is in a constant quivering tremor of constructive change. I cannot understand how the superficial impression prevails among some scientists that earthquakes and volcanic eruptions are signs of the earth's destruction.

"The earth is a great active, living, celestial mechanism, containing within its interior potent energies ever capable of repeating in the future processes which have taken place in the past.

"These processes are not destructive by any means; they are the growing faculties, that instead of imperilling the life of the earth, establish its indestructibility.

"From the unexplored interior of the earth comes the creation of such by-products as compose its elemental character.

"The crust upon which we live, the oceanic waters concealing a far greater topography, and the atmosphere surrounding us, are but by-products of the intensely heated, terribly expansive and ever-active matter of the unexplored interior.

"It has always been incomprehensible to me, therefore, how the phenomena of volcanic eruptions always seems to give the impression that the earth is in a stage of dissolution.

"How can dissolution occur in the actual expression of internal life sources that these earthquakes so vividly declare for us? This material, which is the inner meaning of the external life of our planet, has been the heart and blood of its existence, continuously pulsating through its terrestrial body, a physical certainty of growth.

"The escape of this material to the exterior is known as volcanism, and the by-products of volcanism are liquids, solids and gases.

"ROCKS" A GENERIC TERM.

"The solid by-product we call rocks, whether original volcanic ash or lava, or the watershed, far-transported muds of the ocean's border.

"There is as distinct a purpose in the natural law of volcanic eruption as there is in the downfall of rain that moistens the parasite life of plants on the crust of the earth.

"This rocky crust of the earth is always being added to by the volcanoes and being torn down and washed away by the elements and the material deposited along sea borders. Not only this, but the rocks are being folded, fractured and otherwise broken or deformed by the great shrinking and settling of the earth's crust as a whole.

"The contraction of the earth's sphere is the physical shrinkage of

age that is measured in aeons instead of years. The prehistoric convulsions of the earth before man inhabited this planet were terrific, almost inconceivable.

“Whole forests sank a mile deep!

“The displacements that occur in the ceaseless readjustments of the life of the earth are not always sudden catastrophes of great violence, however.

“Most people in observing mountains think that the great forces which brought about their deformation are phenomena of the past, but these transformation movements, scarcely perceptible sometimes, are going on as much to-day as they ever did.

PHENOMENA OF PRESENT.

“It is these movements which make the earthquakes, and the Sicilian horror, from a geological standpoint, can only be looked upon as one of the dislocations which are constantly going on since the earth first formed a crust and which will go on until it is cooled to its centre.

“It may be startling to realize that we have an earthquake every fifteen minutes, perhaps, but no one feels them, or is conscious of these tremors. The earthquakes of modern times bear the same comparison to the earth's evolution of life measured from its beginning.

“There have been greater catastrophes in geological history than any earthquakes observed by man.

“The European and American Mediterranean area seem both to have been sites of great weakness and movement. There is evidence in our own West Indies that in late Eocene time, before man is supposed to have arrived on the scene, there were vast and sudden disappearances of land area beneath the sea, and that the crust has heaved up and down through thousands of feet several times.

“In the rocks of Barbadoes, for instance, it is recorded that a forested land area went suddenly and rapidly down until it was a mile deep. There it was covered with deep-sea animal oozes and mud. After a time it was again rapidly elevated into land, and carved into hills by the rain. Again it went down suddenly, before the topography could be leveled by the erosion, which wears down all mountains in time.

"Since this last submergence it has gradually risen to 1100 feet above the sea, all draped or veneered with coral reef rock. The myth of the Atlantis is undoubtedly founded on some occurrence of this kind.

"All volcanic action is constructive, not destructive, to the life of the earth. I cannot see how it is conceivable that we are on a dying planet or on a combustible sphere that has no intelligent purposes of growth in its phenomena!

"I cannot see how the world can come to an end in the sensational manner of some gigantic disaster.

"It is foolish to anticipate or to attempt to predict the great earthquakes with certainty, although science may yet help us out.

"It is certainly much more foolish to encourage the illiterate and superstitious in ideas that the world may come to an end, as was done in this city a few days ago.

"The world can never come to an end!

"It may some day in the infinite future grow old, cease working and quaking and die as the moon has died. But even then it will not come to an end, nor will it be destructible.

"No human mind of intelligence can conceive of a method whereby it can be destroyed.

"Better dream of it as a future finished derelict in the great milky way, or some other cemetery of finished plants.

NO EARTHQUAKE WEATHER.

"The temperature of the interior matter, in the centre of the earth, has been variously calculated, but I am not of the opinion that there is any certainty in these conclusions. The temperatures that are formed in mines, for instance, vary. There is no scientific certainty, therefore, in these figures. The scientist always encounters the unknown, the unknowable, and we can only speculate to the best of our ability by scientific precedent, by weeding out the true from the false.

"For instance there is an impression that there is a condition of the atmosphere, preceding an earthquake that helps to predict and forewarn. There is no scientific basis for the calm that prevailed in San Francisco for a long time of what they called earthquake weather. Rain or fog is

no prediction of an earthquake any more than sultry temperatures, or thunder and lightning have anything to do with it.

"The clouds that usually hover over active volcanoes have no immediate relation with an earthquake, as is frequently supposed. The clouds are a natural evaporation of the steam and gaseous substances thrown out of the crater.

"The plant and forest life of the crust of the earth is only a parasite life that draws its substance and food from the universal volcanism that supplies it with material to blossom and flourish.

"Proceeding from the contention that every part of the earth's material is a by-product of the inner activities of the centre of the earth, the world's obligation to that activity makes the process of adjusting earthquakes a promising assurance of the continuity of our planet.

MOVEMENTS GOING ON.

"Quake movements, more or less imperceptible, are going on all the time in many places every day. There is no guarantee, nor, in view of this theory, would we wish to have one, that the earth's tremors will cease.

"Professor Penck, the distinguished German geologist, with whom the Kaiser recently honored this country by sending him as an interchange lecturer, gave an illustrated lecture in New York a few weeks ago, wherein he showed the effects of some of the great movements of the folding and sliding Alps.

"These geologic movements are going on in many places to-day. Occasionally they move with a jerk, and then it depends on who is in the way.

"This is what happened in the awful disaster in Sicily, that has happened in the history of this world as far back as we can read about it.

"No one knows the hour or the place where the mountains will slide of the sea climb over the land—but the earth must not be deprived of its geological privileges to build and rebuild, because its crust is inhabited, covered, by parasites—human or otherwise."

Dr. Harry Fielding Reid, professor of geological physics at Johns Hopkins University, and one of the leading authorities in the United

States on seismic disturbances; attributes the earthquakes in Southern Italy to a general dropping or sinking of the earth in that locality.

"Southern Italy," said Doctor Reid, "seems to be located in the midst of what may be termed earthquake territory. Seismic shocks occur there more frequently and at almost regular, perhaps I should say, irregular intervals. The whole section of the country seems to be sinking in pieces, and I personally think that the shock was due to this general dropping down of that portion of the earth's surface."

Professor William H. Brewer, of Yale, believes the earthquake in Italy was due to the same conditions as that which caused the San Francisco disaster, namely, a fault in the earth's surface.

He thinks what has been described as the tidal wave was a disturbance of the water in the Straits of Messina which caused it to recede and then to rush back, temporarily engulfing the land which had slipped.

VIEWS OF OTHER SCIENTISTS.

Prof. Eric Doolittle, of the University of Pennsylvania, explained the causes, saying as a prelude that the "firm old earth was firm only by comparison.

"Until twenty years ago," said the professor, "it was believed that the core of the earth was a molten ball. Darwin demonstrated that this could not be so, and it has come to be believed that this core is as hard as steel. With this new belief came a new understanding of the causes of earthquakes. It is no longer believed that the lava from a volcano is belched from this ball, following the breaking of the crust of the earth.

"Volcanoes occur in mountainous districts, and mountain chains follow the sea. The mountains are regarded as rock formations pressed up through the earth by the pressure of the sea upon the earth's surface. The mountains, in their pressure upon the substance which supports them, develop intense heat at their hidden bases, creating molten masses there. When the strain of their weight reaches a certain point balance is disturbed and the earthquake results, with perhaps a discharge of this molten mass upon the surface of the earth as it seeks a vent.

"A multitude of elements may cause an earthquake. The sea may press upon the earth, the strain of its weight falling finally upon some

subterranean spot weakened by pressure, and cause a quake in the redistribution of this weight. The sediment which is brought down to the sea by rivers is an element to be considered, changing the force of gravity at the spots at which the deposits are made."

Perhaps the oddest theory advanced was that of Prof. George J. Rupprecht, who wrote:

"Many opinions of scientists and others have been advanced as to the probable cause of the many earthquakes which have shaken up old mother earth lately, and especially of Italy's great disaster, but I have never seen given one plausible reason or explanation for them yet.

"I believe I can state one of the most reasonable explanations for this spasmodic upheaval of the outer rind of the globe, upon and from which we all live, that has been brought forward yet.

AN ODD THEORY ADVANCED.

"Our old mother earth is a live lady, in which the secret forces of nature are at work incessantly, constantly building up its interior, the core of which is believed to be a fiery, molten mass, creating by its intense heat fluids and gases from the solid part, which are distributed through the same solid part in the shape of subterranean rivers and lakes in the shape of gas, water and oil; the volcanoes are only natural safety valves for the over-accumulation of these products.

"But within fifty years the noblest parasite on this old mother earth—man—has found a way to tap her bowels and take out in steadily increasing quantities the oil and the gas, to make money out of it.

"Now if you take say 100,000,000 barrels of oil out of a well in Pennsylvania it is called Pennsylvania oil, but this same oil taken out in this State may drain a lane many miles in length, width and height down in South America, up in Alaska, over in Italy, or possibly right here under one of our big cities. It must come from somewhere and must leave an empty space somewhere, which will not be supported by timberwork, as is done when the minerals are taken out.

"As long as the oil or even the gases are in that lane they keep intact the equilibrium and everything remains normal, but once empty the danger of a collapse down below is here, and no matter how deep inside the

earth this happens the movement will expand to the surface; if not at once, then sometime later on; and this seems to be exactly what happened in the cataclysm which visited Italy.

"Another point in connection with the unlimited abstraction of this oil from the earth I will raise right here. Has any one ever ascertained yet whether or not this same oil, which is taken in millions of barrels yearly from the planet from which we all derive our living, does not form an absolute necessity to the life of this same planet, as much necessary, perhaps, as blood is to the living parasites on it?

"Nature points a way to expel the unnecessary water by wells, and for the gases it provides volcanic craters; but I have never heard of a river of oil, so it seems to me that old mother earth needs it and wants to keep it; but as there are "millions in it," the oil men squeeze it out, never minding about the future."

With reference to Sicily, it is well to make note of the fact that an American volcanologist, Frank Alvord Perret, has predicted disaster on Mount Etna for two years past. Mr. Perret, who was decorated by the Crown of Italy for his splendid service to science and to humanity on Vesuvius in 1906, wrote in the *World's Work* of November, 1907: "By the rational methods of scientific research, we know that a great eruption of Mt. Etna is impending, the only uncertainty at present being which side of the mountain will break open." Great volcanic eruptions are preceded by great earthquakes, and the Messina disaster came on an earthquake date ("terrestrial maximum of gravitational stress") actually platted in advance by Mr. Perret on his diagrams for 1908.

Like Dr. Omori, he is a man whose whole time is unselfishly devoted to these studies, but he has no observatory and no adequate means of support. A few business men in Springfield, Mass., last year came valiantly to his aid, and now their foresight is worthy of all honor. When young men think of making science their life-work, it would be well to remember Pasteur, and to consider carefully whether the "highest" development of the investigative faculties may not concern itself with humane rather than with historical motives.

CHAPTER XIII.

MESSINA WRECKED MANY TIMES.—MOUNT ETNA'S WRATH.—SCENE OF
CATASTROPHE.—CITY FOUNDED BY PIRATES.—ITS AWFUL HISTORY.
—RESEMBLES LISBON.—REGGIO AND ITS CATHEDRAL.

THE portions of Southern Italy and Sicily laid waste by the earthquake, tidal wave and devastation of Mount Etna are not only those which have been most sorely afflicted in the past by great convulsions of nature, but are those which, for the sake of art, historical interest and certain commercial aspects of themselves and the world at large, were best worth guarding against destruction.

The path of the great disaster ripped through the Straits of Messina, with Reggio di Calabria as a starting point. These two cities, Messina in Sicily and Reggio, her Italian neighbor, were more completely demolished than any others, and from the population of these two were most of the thousands of victims of the gigantic death list contributed.

Catania, in Sicily, the most populous city next to Palermo, but in reality scarcely more than a wraith of its ancient self, suffered incalculable damage from the tidal wave which flanked the earthquake like a solid wall rising from the heaving seas.

Syracuse, once the most important of the Sicilian towns, on the lower curve of the bay, was swept by the tidal wave and the devastation included one of the finest of the cathedrals of the country.

Mount Etna, which disgorged itself steadily all day and poured its deadly lava down toward Messina, contributed to the slaughter a more vicious eruption than any since 1886.

Messina, which suffered most under the catastrophe, and which sacrificed more of her inhabitants to the final score of dead and injured, is, next to Palermo, the capital, the chief commercial city of Sicily, with more than 100,000 inhabitants.

Including in this count the surrounding country and small suburbs adjacent the number is 147,106.

It is the seat of an appellate court and is an archbishopric, and boasts

a university unexcelled elsewhere in Sicily. Its university is situated on the Faro, or Stretta de Messina, a promontory due north of the city of Messina, which juts into the straits and reaches nearer to Calabria than at any other point.

Directly across from the Promontory de Faro is the great Calabrian rock Scylla, over which is the town Scylla.

This rock and the whirlpool beneath it, both of which are now lost under the lashings of the angry seas, formed the direful Scylla of Greek mythology, which with the Charybdis of eddies and unbridled currents in the straits, were thought by the ancients to be fraught with infinite danger. These cross currents have in recent years been greatly tamed, and Scylla is a delightful little port with no reminiscent suggestion of her quondam horrors.

SCENE OF CATASTROPHE.

On the Sicilian shore of these tumultuous straits is a range of rugged peaks. They lend dignity and grandeur to the wide stretches of scenery, and are second in all Sicily only to Palermo.

The harbor of Messina, which is formed by a peninsula in the shape of a sickle, was considered one of the best in the world and has an extensive steamboat traffic.

In 1899, 2,446 steamers entered the port, and 2,010 sailing ships, though more recently the trade has fallen behind that of Palermo. Oranges and lemons are the chief export, and of these more leave Messina than are sent from the whole of Italy. Almonds, silk, olive oil and wines have been staple exports also.

Messina was, comparatively speaking, well constructed throughout.

It had several beautiful streets, chief among which is the Via Garibaldi, named after his memorable invasion of Sicily when Messina was his point of attack.

About the edge of the brilliant harbor runs the Marino, or Corso Vittorio Emanuele.

Parallel to the Marino and the Via Garibalda are the Corso Caour and the Via dei Monasteri.

The original city lay between the torrents of Portaelgni, but it was

extended north and south under Charles V, and has since incorporated within itself the suburbs of Zaera and San Leo.

Owing to the frequency of attack made upon the city by the warring elements about her Messina contains fewer relics of antiquity than any other Sicilian city.

Foremost in its list of attractions was the Cathedral of La Matrice, an edifice of the Norman period begun in 1058 and completed under Roger II.

It was damaged by a fire during the obsequies of Conrad IV, and in 1559 the spire of the campanile was burned. In 1862 the interior was modernized, but in 1783 the campanile and transept were overthrown by the earthquake, so that but little of this finest of churches was left for the devastation of the latest calamity.

The oldest Norman church in Messina was the Santissima Annunziata dei Catalani, situated in the small Piazzì de Catalani, upon the site of which a temple to Neptune is said once to have stood.

MANY RELIGIOUS ORDERS.

The city was remarkable particularly for its great number of small convents and monasteries. Almost every order in the world was represented there by some small house.

The dismantled fort of Castellaccio, situated high above Messina to the west, from the tower of which Mount Etna and Catania can be seen, is one of the old landmarks of the city.

Messina lies on the line of contact of the primary and secondary formations, on which boundary earthquakes between Etna and Vesuvius are always most violent. Its vicissitudes number not only terrible strokes from natural sources, but political bludgeonings as well.

It is 2,700 years old, but never in all its history has it had any degree of peace. Its earlier years were given over to struggling against the invasions of the Cumæan pirates, the Saracens and the Normans.

It was founded by Cumæan pirates and Chalcidians in 732 B. C., and was governed by the laws of Charondas.

At the end of the fifth century B. C., the town was seized by fugitives from Samos and Miletus, and soon after fell under the dominion of An-

axilas, the tyrant of Rhegium, who introduced Messenians from the Peloponnesus, by whom the name was changed to Messina. The tyrant's sons were expelled a few years after his death and the constitution was re-established.

In the great Athenian war with Syracuse the city remained neutral.

In 396 B. C. the town was destroyed by the Carthaginians but was rebuilt a few years later by Dionysius of Syracuse only to fall again into the hands of the Carthaginians under Hannibal in 269.

The first Punic war, however, left the place in the hands of the Romans and the place was of importance second only to that of Syracuse and Lilybaeum in Sicily during a period of Roman occupation lasting for several centuries.

In 831 A. D. the town was taken by the Saracens, but in 1061 it was taken from them by the Normans.

ITS EVENTFUL HISTORY.

The city prospered greatly during the Crusades, being a favorite rendezvous for soldiers from the Continent en route to the Holy Land. In the Middle Ages also it became a flourishing commercial city.

Its commercial importance disappeared after a bitter struggle between the aristocratic faction, or Merli, and the democratic faction, or Mavizzi, in 1674. The democratic faction appealed to the French and the other to the Spaniards.

The former faction were at first victorious but eventually were deserted by the French, the city was taken by the Spaniards, and when the struggle was over the population was reduced from 120,000 to about a tenth of that number.

The town never fully recovered from this disaster. Whatever recovery was made was neutralized in the eighteenth century by a series of disasters.

In 1740 about 40,000 persons died of the plague, and in 1783 the town was almost entirely overthrown by the great earthquake of that year.

Great damage was caused by bombardment in September, 1848.

The cholera carried off no fewer than 16,000 victims in 1854, and earthquakes in 1894 and 1906 also caused loss of life and property.

In 1860 the town was occupied by Garibaldi. It became a part of united Italy the following year.

In respect to the feature apparently resulting in the greatest loss of life the Messina disaster bears a close resemblance to the great earthquake of Lisbon, which, on November 1, 1755, laid half the city in ruins and caused the death of approximately 40,000 persons.

Catania, just at the foot of Mount Etna, which is sharing the honors between the tidal wave and streaming lava, is the most populous city of Sicily except Palermo.

It is the seat of a bishop, and a university founded in 1445, which at the present time has 1,000 students, the flower of the intellect of Italy. It is situated about the middle of the east coast of Sicily and is one of the busiest and most prosperous parts of the island.

RESEMBLES LISBON.

Among other native products of the rich and fertile district about it are wine, grain, linseed and almonds, while large natural deposits of sulphur add materially to the wealth of the community.

Fully 8,000 vessels enter and clear the port annually. Catania is the seat of a notable Academy of Natural Sciences, founded in 1823.

It has taken a prominent part in investigating and developing the natural resources of Sicily, particularly has attention been paid to the possibility of earthquakes, and every possible research has been made that might serve to give warning of impending catastrophe and thus minimize the damage and loss.

Catania was founded by the Chalcidians in B. C. 729, and despite frequent severe losses from earthquakes, its people at least once in every century since have valiantly rebuilt the city, and its prosperity has grown rather than diminished, in its more than 2600 years of continuous life.

Catania has suffered materially from its proximity to Mount Etna.

In March, 1669, a fearful eruption of the volcano took place, which served to give to Catania one of the most interesting of the local folk

tales which are connected with the many disasters which have overtaken it.

In that catastrophe the Monti Rossi was upheaved, and an arm of the lava stream 14 miles in length and 25 feet in width, flowed in the direction of the town. The pious inhabitants, however, so the story goes, averted its course by extending the veil of St. Agatha toward it, in consequence of which the stream took a westerly direction near the Benedictine Monastery, and descended into the sea to the southwest of the town, partly filling its harbor.

An earthquake in 1693 wiped out every vestige of the then city and affected the whole island.

Although the scene of a wealth of classic historical and literary events, not a single structure in the place antedates the year of this great disaster.

DEEP BURIED RUINS.

A number of interesting and important ruins have been discovered in the city, deep buried by the centuries.

In the eighteenth century the first of these were made by Prince Ignazio Biscari. His collections, which Goethe visited in 1787, are exhibited in the Museo Biscari, one of the notable sights of Catania, now probably reduced to wreckage.

Among other sights of Catania which attract tourists are a noble statue of St. Agatha, on an ancient column, in the Piazza de Martiri; its famous antique elephant in lava, bearing an Egyptian obelisque of granite, one of the most notable curios of Italy, its history shrouded in mystery.

The wreck of a cathedral begun in 1091 is also to be seen. The building was almost entirely destroyed by an earthquake in 1169. The apses and part of one transept alone remain, except for two sarcophagi containing the dust of fourteenth century rulers of the Aragonese family. A chapel of St. Agatha contains the relics of the saint, who was cruelly put to death in the reign of Decius, 252 A. D., by the praetor Quintianus, whose overtures she had rejected. Her crown is said to have been presented by Richard Coeur de Lion.

One of these sarcophagi is conveyed through the city during the

February festival, by men in white robes, accompanied by the Senate. The women on these occasions cover their faces so as to leave but one eye visible, and amuse themselves by coquetting with the male population.

The remains of the Craeco Theatre, which from an interesting feature for visitors, are mostly underground, and only portions of it can be seen by artificial light.

The suppressed Benedictine monastery of San Nicola, which was transferred from San Nicola d'Arena in 1518, is also one of the most charming of the city's attractions to visitors, as is the comparatively newer monument to Bellini, which is on the Piazza Stesicoro.

Across the Messinian straits to Reggio Calabria, so called to distinguish it from Reggio nell'Emilia, is one of the prettiest trips in either of the two countries, bridging the gulf between Sicily and Italy proper.

In Reggio the devastation of the latest tragedy has been almost as widespread as in Messina, although Reggio is far smaller, and less important from the historical and artistic point of view.

OLD EUBOEAN COLONY.

It has been for the most part safely out of the path of the volcanic eruptions which have destroyed its Sicilian neighbors, though the earthquakes and tidal waves resultant upon Etna's upheavals have struck Reggio as hard as the rest.

This city was originally a Euboean colony. It was peopled in B. C. 723 by fugitive Messinians. Rhegium was prosperous early in her existence, but suffered young from the hardships of war.

In 387 B. C. the town was captured and destroyed by Dionysius of Syracuse; in 270 B. C. by the Romans.

In the Middle Ages it suffered a like fate successively at the hands of the Goths, the Saracens, the Pisans, Robert Guiscard and the Turks.

The town was almost wholly rebuilt after the great earthquake of 1793, the havoc of which is the last at all commensurate with the one Reggio is now suffering.

After 1793 the city presented an oddly modern appearance, alien looking among its neighbors who retained more of their relics, through

their rebuilding processes. Its streets are wide and beautifully kept, and its outlying sections are studded with numerous beautiful villas.

The Reggio Cathedral, a spacious basilica with pillars, dated from the seventeenth century. The Capella de Sacramento, to the left of the high altar, was richly adorned with colored marbles. On the façade is a quotation from the Acts of the Apostles. The wide, straight Piazza del Duomo descends from the heart of the city straight to the sea, where the ancient baths of the Greek and Roman periods, with exquisite mosaics, and elaborate heating apparatus, have been excavated.

Adjacent was the interesting Museo Civico, containing fine terra cottas, lamps, vases, statuettes, and examples of curious early native art with unusual decorations—now all probably lost to the world as the Alexandrian tomes.

One of the most interesting works in the collection in the Museo Civico was a relief of women dancing of the sixth century B. C., with its architectural framework painted black, red and yellow. One of the far-famed Laocoon groups was also housed here.

SMALL CITIES WHOLLY OBLITERATED.

In the piazza adjoining the railroad station was a fine statue of Garibaldi, under which a military band often played. Back of Reggio rests the imposing, forest-clad Aspromonte, due north of which is Scylla.

The smaller cities which are buried under the streams of lava or deluged with the slime and water of the tidal waves all bear the same general characteristics of these three cities whose share of the burden was heaviest.

All the small cities in Sicily and Calabria have kept their little quota of historical relics jealously guarded against invasion and sacrilege. Each has been forced to build over again the homes and streets in which its populace joyed. Each has known the same tribulation, learned through long sojourn near Etna, the great monster of Southern Italy and Sicily.

Many of the very small cities were wholly obliterated, particularly the tiny coast towns which edge the harbor.

So much for the historical, topographical and physical features of the stricken kingdom. No land is more blessed on the one hand nor

worse cursed on the other. Yet it is by delving into the personal characteristics of the people that one best learns to sympathize with them in their misfortune and to appreciate their fortitude under circumstances that would upset the mental poise of a far more phlegmatic people.

These personal peculiarities have frequently been commented upon, but a repetition of some of the odd things in that land of contrasts may not be inappropriate at the present time and in the present connection.

In traveling about Italy, especially through the stricken regions of Sicily and Calabria, says M. J. Reynolds, an American sees a number of things which strike him as funny. For instance, an Italian will take his wife into the smoking car with him and give her a cigarette to smoke in the most unconcerned manner in the world. No car is set aside as a smoker, in American fashion, but in certain compartments of the regular cars smoking is allowed and in others not; and women sit in the smoking compartments as much as in the others. If they did not they would not sit anywhere. The small size and crowded condition of Italian cars are astonishing to Americans.

STRANGE TO AMERICANS.

The fact that no trunks are carried free is another surprise. The result of the latter regulation is that no one travels with a trunk in Italy. He carries, instead, an amount of hand luggage which is appalling; and when there is no space left for it in the racks of the compartments, piles it up, mountains of it, in the tiny footway which runs between the ends of the compartments and the side of the car, until this passage is almost impassable.

There is no drinking water on the cars. At the stations a water seller may come by and sell you a glass of water for a cent, but I have traveled for hours on a hot summer day without happening to strike a water seller at any stop, or being able to get a drink.

The paucity of things sold on trains or in depots is strange to Americans. On the big through trains of the peninsula there are sometimes dining cars, from which things can be got. In stricken Sicily these usually are lacking. But there are no salesmen either of things to eat or

to read on the trains; and off the main lines of travel nothing can be bought at the depots excepting water and dry bread.

I have traveled for hours in Sicily and seen nothing else for sale at any station. I have seen a city of 60,000 inhabitants in Sicily where there was absolutely not one thing either to eat or drink to be had in the station or anywhere around it.

The nearest restaurant was many blocks away, in the business district. One cannot imagine a railroad station in an American city of that size which would not be surrounded with eating and drinking places.

The fact marks one vast point of difference between the Italian and American public. All that careless, useless, unnecessary eating and drinking which goes on in America of nuts, candy, fruit, sandwiches, ice cream, soda water, tea, coffee, beer, and so on, does not exist in Italy.

The Italian eats when hunger obliges him to eat. It is with the greatest rarity that he buys anything to eat simply because it looks nice and he thinks it would taste good.

ICE CREAM UNAPPRECIATED.

The amount which the cafe men have to give to induce Italians to eat ice cream is astonishing. Italy is full of outdoor cafes chantants in summer. A musical programme is given from 8 to 11, or longer, and everybody passing can hear this, so that the proprietor really furnishes free music for the public; and the public stands outside the rail and listens, in enormous crowds.

An amount of space which in New York would cost a prodigious sum is filled with chairs and tables which begin to fill early in the evening by those who want good places.

The most expensive ices at these places in Naples cost twelve cents, and they run down to six. Besides that there are half portions; and when a family party comes in of several members, two or three of the orders are sure to be half portions. I have seen persons loaded with jewels order half portions. For this sum they occupy their chairs the whole evening. They never order a second time.

Thus the ice becomes a function; a regular, established institution, a show ticket and a means of enjoying the society of one's fellow men.

But to the American in Italy in hot weather this whole subject of ice cream is a painful one. The American in summer loves to finish his dinner with ice cream. Nothing else comes to "like the benediction that follows after prayer."

It is an astonishing fact that restaurants do not sell ices in Italy. If you want ice cream for dessert you must get up and go to a cafe for it.

This is very annoying to an American, largely because of its inane lack of sense. The manner of serving ice, and even water, is also annoying.

The Italian waiter is an admirable fellow, polite and efficient. But there is one thing he does not know and never will learn. The first thing a waiter does at any decent eating place in the United States, particularly in hot weather, is to clap a glass of ice water down in front of you before you have said a word. In Italy one orders ice like any other order, and it takes as long to get it as a beefsteak.

Moreover, the waiter immediately carries off the water bottle to fill it with fresh water, and you get it back perhaps when your first order is served.

There is something funny about tips in Italy. Just as the average restaurant tip of the ordinary middle-class multitude in America is ten cents, so in Italy it is two cents. This seems very small; but you give the same tip to the man who brings you an ice or a glass of beer or a cup of coffee, which doesn't seem reasonable.

TEMPLE USED AS JAIL.

New vistas open up in this tip question as one studies the Italians and their ways. There is a natural feeling in the human breast that makes one dislike to pay more than other people are paying for the same thing even when it is less than one would pay at home.

I determined to pay Italian tips if I could find out what they were. I never shall forget the first time I did it. I went to visit a temple of Venus in Sicily; an old, old ruin that stood there on its mountain top 500 years before the Christian era. Part of it is still used as a city jail, and the jailer showed me about.

The jailer was a civil man, and bookish, for I saw a copy of "The

New Anthropology" lying open on his table, and he was well informed in the history of the place he showed. At parting I gave him four cents with fear and trembling, reflecting what any city jailer in America would do to me if I offered him four cents.

But the guardian of this classic spot took it and said "Thank you;" and there were two of us.

At the Royal Palace at Genoa there is a perfectly astounding personage at the door; the most imposing creature I ever saw except the Pope's guard at the Vatican in their crimson uniforms, designed by Michelangelo.

This Genoa man is a giant, and he wears the most elegant clothes, finished off with the most sumptuous tall silk hat. He took my umbrella away from me when I went in. All over Italy they take your umbrella away from you and you have to pay to get it back. I always pay two cents, as the Italians do; but I confess when I thought of offering that splendid creature two cents the cold chills ran up and down my spine.

I thought of making it three, but what was the good of three? Nothing less than a dollar would go with those clothes.

TIPS KEEP YOU GUESSING.

So I braced my courage to the sticking point and tipped him the two cents, and he not only took it and said "thank you," but lifted his hat and smiled upon me in truly royal fashion. What is one to think of a man 6 feet 2, who wears that kind of clothes, who will do all that for two cents?

This whole subject of tips is a disagreeable one to the tourist. He feels picayunish to be considering these small amounts all the time, yet since it is a constant outgo every time he turns around they form an appreciable item in his expense account.

He does not wish to be mean, or to be thought mean, yet there is no reason why he should pay 100 per cent., not to speak of 400 or 500 per cent., more than others pay for exactly the same service.

If the thing could only be gotten to a business basis, so that on going to a hotel of a certain grade and price he would know that on leaving he would be expected to hand to a designated person or place in a

designated receptacle a certain sum for the employes, to be divided as they saw fit, he and they would know what to expect.

But this is the last thing on earth they wish to do in Italy. They wish to leave it all in uncertainty, so that they may profit by the ignorance or the generosity of the tourist. Half the time when one asks the price of some small service they will reply, with a flourish: "Whatever the signor wishes."

For instance, I had been in the habit of going to a certain convenient shoeblack stand in Messina to get my shoes polished. The first time I asked the man "How much?" and he replied, with extreme politeness, as if it were an affair between princes: "Whatever you wish." I gave him 4 cents, and continued thereafter to pay that sum.

MUSEUM ATTENDANTS.

After a while I found that nobody in Italy ever gives more than 2 cents to have his shoes shined. That sort of thing multiplied by every hour in the day grows irritating. In museums attendants come up and address smiling, pleasant remarks to the tourist, volunteering bits of information about any object at which he may be looking. If he answers this remark civilly, or answers it at all, it simply means a tip.

He follows you, keeps up the conversation, and you must pay to be rid of him.

The attendants in the Naples Museum are the most shameless in Italy about this. The only way in which one can protect himself is not to answer them at all when they speak to him, or to turn on them bluntly and say that he wants nothing; neither of which processes is civil nor agreeable.

At the Naples Museum I paid one lira to enter, and three liras for a catalogue, eighty cents in all. I considered this enough, and proposed to pay no more; in consequence of which I was made to feel by the manner of the attendants that they considered me poor white trash.

In museums at Rome, as I passed out of rooms in which I had said not one word to the attendants or they to me, I have had them jingle the money in their pockets at me as a gentle indication that I ought to tip.

One knows not which to despise in such cases, the system or the

man. If it is the Government which does not pay its employes enough to live, and leaves them to get their salary out of the public in this manner, it is a despicable system, and the man is not to blame.

If the Government does not pay a living wage, then the man lowers himself to the level of the beggars who flock every door which tourists pass.

The system follows one into the churches. Entrance is nominally free, but inside various persons follow one about in search of a tip, after the style of the museum attendants.

Certain portions of the church also will be closed, and you have to pay some one to unlock the door; or a printed notice will state that this can be seen only by "permission" to be had at some distant point; but this "permission" always means something slipped in the attendant's hand.

Of course one may say that these tips are a very small price to pay for seeing buildings famous in history and art, which is perfectly true. On the other hand, it is because of these buildings that tourists spend annually millions in Italy, showering a rain of gold upon her railroads, hotels and shops.

Take the tourist business out of Italy and the country would sink instantly to a poverty and misery undreamed of in her direst straits.

SIGNS ARE NEEDED.

It would be a distinct convenience to travelers if they would put up a sign in the Naples Museum, "Questions Answered, One Cent Each."

We are a business people. We are willing to pay the regular price for anything we want, if we can only find out what it is. But it is wearing to feel that one is either covertly smiled at for a greenhorn or cursed for a miser with every tip he gives.

Three times only have I had tips refused in Italy; as it so happened, all by women, all in or near Messina, and all tips which were well deserved. One was after a long and trying siege of dressmaking in a department store. The dressmaker had been most obliging and efficient, and at the end I felt like giving her something for herself, aside from what I paid the store. Smilingly but most firmly she refused.

Another time, when exploring the beautiful mountain country that lies back of Messina, I followed a path through the vineyards which, instead of leading me where I expected, conducted me into a peasant's backyard. An old woman came out, and with the greatest kindness not only directed me to the right path, but went a piece to show me the way.

I offered her a tip, but although she was barefoot she would not take it. She asked me, instead, where I came from. When I said America, her face lit up with pleasure and she said, "Oh, yes, America. I have two brothers in Buenos Ayres!" "America" means "Buenos Ayres" to the Genoese, and in fact they have almost changed the language of Buenos Ayres into Sicilian dialect.

Another woman whom I met in Genoa, not a peasant woman by any means, said to me that she had a relative ill in Montevideo, and asked me if there were good doctors there. But this engaging mistiness as to American geography can be paralleled in the cultured classes all over Europe, including England.

ANOTHER TIP REFUSED.

My third tip refused was during the same long walk, when, warm and tired, I spied a little wayside inn, with some seats under the trees. I sat down, and a miserable, barefoot little kitchen slavey came out to take my order.

I found they had nothing to sell but wine, which I did not care for, so I asked her to bring me a drink of water. When she brought it I offered her two cents, and pressed it upon her; but she would take nothing, although the wages of such a girl cannot be more than a dollar a month, aside from her board and lodging.

Before I leave the tip question I want to tell of one awful escape I had in this connection. Down in Trapani, the Sicilian town, where I spent six months, they were slowly getting together a museum in an old cloister appropriated by the Government for the purpose.

It was not yet open to the public when I was ready to come away, so I went there one day and sent in word by a workman to whomever

might be in charge that I was a stranger, about to leave the city, and that I would like very much to see what was inside.

I received permission to enter, and was looking about with much interest when a civil-spoken man appeared and began to explain things. He showed me all about with the greatest courtesy, while I meanwhile was consumed with inward anxiety as to whether I should tip him or not. There was no sign to tell me who or what he was.

He was educated, but then so was the archæological jailer who took my four cents. But I looked this man in the eye, I took his measure and decided he was not to be tipped.

The next day on the street with an Italian acquaintance I noticed my museum friend.

"There," said I, "there's the man who was so nice to me in the museum."

NO WONDER HE LAUGHED.

My companion choked with laughter.

"I'd have given a dollar," said he, "to have seen you try to tip him 2 cents. That's Count Pepoli, the founder of the museum."

Italy would gain friends and lovers also by keeping her beggars off the streets. How can any one respect a municipality which saddles off the support of its paupers upon strangers and foreigners? And which permits children to grow up beggars in the face and eyes of the public, begging every day at the same place and putting in regular business hours at it, while a man or woman stands by and teaches them the trade? And it is all unnecessary.

There is not a beggar in Milan, Florence or Genoa. Milan and Genoa are great, modern, industrial and commercial cities. There is more prosperity and less poverty there. But there must be poverty in Florence, she is neither industrial nor commercial, and she has no beggars.

Neither do the street salesmen of postal cards and souvenirs make nuisances of themselves. They ask you once to buy, and if you refuse they say no more.

Whether this is the natural good manners of the Florentines, or whether it is due to city regulations I do not know. In everything con-

nected with Florence, in all her ways and manners, there is a refinement, a self-respect, a dignity and courtesy which give a charm to life.

The voices of the Florentines are soft and sweet; their manners are pleasant and kind; their city is clean and beautiful; their hotels and restaurants good and cheap. And that city is belted and circled with wealth. For miles in every direction the great villas are owned by rich Americans, English and Germans, who live there permanently simply because it is such a pleasant place to live and spend money in.

Sicily is by no means a bad place for beggars, although nowhere in the kingdom is poverty deeper. There is a sort of fierceness of pride about the Sicilian which impels him to put up a good front to the world in the midst of his starvation.

In six months in Sicily I never saw a woman barefoot, though one can see them every hour in Naples and all along the Riviera, east and west of Genoa.

To the Sicilian's notions it would be indecent for his women folk to go barefoot, and somehow or other he will keep them shod. Neither did I ever see women in Sicily dragging heavy trucks full of freight, which I saw both in Pisa and Como.

A FREQUENT PLEA.

The hotbed of beggary in Italy is Naples, and the beggar's plea in Naples is appalling to the American who understands it. The gentleman who is "carrying the banner" or "panhandling" in New York, or who finds his way up to one's kitchen door in the apartment house, says: "Lady, I've lost me job and ain't been able to find no work yet. Could you let me have ten cents to get a bed to-night?"

He makes it appear a temporary and unexpected lapse from the working class into the submerged tenth, and submits his plea in a casual, off-hand fashion. But the beggar of Naples, usually a woman, says:

"For the love of God, madam, one cent, one cent, to keep my child from starvation!" And she shows you the child, a wizened, awful baby; and clasps her hands in misery, and lifts her agonized face in a way that banishes sleep that night.

Perhaps it is a cold winter night—for winter nights are cold in Na-
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ples—and one comes upon her sitting on the cold stone pavement, sleeping with her head against the stone wall behind, and two or three little children huddled around her, sleeping with their heads in her lap, not one of them with shawl or wrap.

She rouses from her lethargy, and after the passerby comes her ghastly cry, "For the love of God, we are starving to death—one penny, one penny!" so it goes, night and day, in Naples.

Rome is not so bad, but there the place of the beggars is taken by the postal card and souvenir sellers, who almost destroy the pleasure of life. They stand in crowds about every point where tourists pass, and surround them in gangs with persistent appeals to buy.

The only recourse is to order them off brutally. A civil refusal to buy has no effect. This is all an unnecessary infliction upon the tourist, for it does not exist in Florence.

Venice is almost as bad as Naples for beggary, and, considering its size, Pisa is the worst little sink of beggary in Italy. In Venice I encountered beggars who had learned French to beg in just like a guide or a courier. But in Pisa there were beggars who had learned English to beg in, which is the funniest thing in all Italian baggardom. I had long known begging for a profession, but in Pisa it is a learned profession.

CHAPTER XIV.

WHO SHALL IMMORTALIZE THE TRAGEDY?—THE SYMPATHETIC SOUL OF OUIDA.—HER FAVORITE THEMES.—FRENCH PROMPTNESS PLEASES SICILY.—ANOTHER IRELAND.

CONSIDERING that awful blow which fell upon the shores of the Messina Strait in the last days of 1908 this thought recurs with extraordinary persistence:

Had only Ouida been alive!

It is still too soon to tell whether of those now living, working in letters, there shall be born some memorable masterpiece as a result of this cyclopean tragedy. When Last Island disappeared a pen picture by Lafcadio Hearn so marked its going as to assure it in its death such glory as might never had come to it living.

The Martinique eruption is not to be traced by any fine literary monument. Had it not been for Gertrude Atherton we would have the same to say of San Francisco. Neither Galveston's flood nor Baltimore's fire added anything to our store of written art. Shall that be said, too, of Sicily and Calabria? Well, to-day we can only wonder, and wait. Had Ouida been alive one would hardly have had to wait long.

For, of all who have written of Italy, in English at least, it is the work of Ouida that seems fittest for this case; it is in her pages that we find proof after proof that it was her pen that would best have voiced the desolation and despair that have come upon the Southern Italian countryman. It was she, too, who would most have kept the rest of us wondering as to what her attitude would be upon the generosity the civilized world is showing in this stress of her beloved Italy.

The libraries are full of Italianate work in English, we know that well enough. There are novels upon novels by Marion Crawford and by Henry Harland that come easily enough to the mind; and such books as Norma Lorimer's "By the Waters of Sicily" proclaim themselves obviously enough.

Only a few years ago, too, Robert Hichens gave us in his story "The

Call of the Blood," a study of the Sicilian character, and even of the Sicilian shore not far from where chaos and death now reign; and no longer ago than last year he published a sequel to that, wherein he strayed from his villa in Taormina to the Bay of Naples.

Yet—it is neither Hichens, Harland, Hewlett, Crawford, nor the rest of those who, in our language, have painted Italy and the Italians—it is none of these for whom one now longs, seeking the proper voice for this emergency; it is for the voice and the pen of Louise de la Ramee that this occasion cries. For she alone, of all, had ever in her heart the piteous case of the Italian peasant, the Italian country.

Hewlett paints the peasant and the place, it is true; but he uses both as simply decorative subjects for his gorgeous prose; splendid and beautiful women, strong passions, sumptuous colors hold him; he gives us canvases that glow with sunshine and vivid life. Of poverty, oppression, or any of the gray, drab things of life, he tells us nothing. Only one told us of the bitter lives lived by the country people in those sunny lands; that one was Ouida.

IN THE PAGES OF OUIDA.

When Ouida was in her last decline at Viareggio the present writer, being then in Florence, fell with a new zest to re-reading all those many tales of hers which paint Italian life. What a wonderful array it is! The color and the passion splashed on with a vigor and a richness that would furnish a dozen of our quotidian successes in the field of fiction; allowing for exaggeration, for illogic bursts of ill-considered rage, and for all the faults her enemies ever accused her of, it is still in the pages of Ouida that we must look for, firstly, the best account of social, fashionable life in the Anglo-Italian colonies of Florence, and, secondly, the real life of the Italian peasant.

In Hewlett it is ever the lust of the eye. In Ouida it is always the note of pity. It is true enough that you will not find the Calabrian or the Sicilian specified in the pages of Ouida. It is mostly, where she descends to details, the countryman of Tuscany, of the Abruzzi, or the Apennines.

But it is always the Italian countryman for whom she fights.

And what a fight that was! In her novels, in her articles for the English reviews, always, for a score of years, she told the tale of Government and bureaucratic oppression of the peasant, and in innumerable ways she tried to swing the world's pity toward that pitiable creature.

Do you think of the Italian as the happy, singing creatures or simply as the prosperous person who sells you bananas on the corner, or as the grinning Neapolitan who dives after the pennies you have thrown him from your steamer? Well, then do you not know the poverty and misery of him; you must re-read your Ouida.

Was there ever penned, for instance, a more elaborate philippic against Government oppression of the Italian peasant than this author's novel, "The Waters of Edera?" Nor, if you would understand what sort of creatures in our human family are these now homeless on the shores of the Messina Strait, can you do better than read those tender tales, "The Silver Christ" and "A Lemon Tree."

Have we not elsewhere given you pictures of those stricken wretches praying and forming processions amid the ruined streets and lanes? You will find their types, to the immediate letter, in any of those early stories named.

OIDA'S FAVORITE SUBJECTS.

She wrote of Tuscany and Umbria, it is true; but, if never before, she would have been the first to write equally vividly of these Calabrians and Sicilians who now wail and mourn.

Such of us as know our Italy ever so little know that the Italians of the north were wont to look askance upon those of the south. If you alleged to an Italian of the north that you found the Italian in America by no means the best of citizens; if you referred to the Mafia or the Camorra, or the like, he simply shrugged his shoulders, and said:

"Ah, it is those rascals of southerners you mean!"

As if, for all the world, they were no kin of his at all. Again, in the detail of language, you know that the northerner looks down upon the southerner; and the Tuscan looks down on all the rest. But, in face of this calamity, all Italy is one. The whole nation mourns, Prince and peasant alike. Ouida, we cannot but think, would have mourned most

passionately of all, since it is on the peasants whom she loved, the Italian country she adored, that this terrible grief has fallen.

Here, then, is a curious point. No writer who ever lived in her time hated Governments more, more bitterly assailed the plague of modernity, and more openly despised America, than Ouida.

What would she have said had she seen the rest of the world as now, led by America, coming to the rescue of the countrymen she most loved? Never did she lose a chance to berate those authorities who, in their greedy reach for modernization, went about destroying historic places; yet here has come the vast destroying hand of Earth herself, ruining far more than did those who removed the old centre of Florence, or who desecrated the Orti Oricellari, or the Villa d'Este. What would she have said to this?

SOME OF OUIDA'S DISLIKES.

Governments, Kings, and democracies alike, she loathed, because they oppressed and neglected her beloved peasants. To-day she would see the greatest Republic in the world hurrying relief to Sicily; a King, a Queen, Dukes, Marquises—they have all been doing what they could, not by sitting at home and writing orders, but there, on the spot, in the flesh. Here had been food for Louise de la Ramee's thought.

How she was wont to rave at those blind municipal authorities whom she thought determined to make "a petty maritime Pittsburg" of Venice.

How she abominated the "contractors, concessionaires, and jerry-builders, and bureaucratic thieves and foreign speculators" whom she accused of conspiring to ruin her beloved ancient Italy!

Yet all that they did is little compared to what has now been done by Nature herself, the greatest iconoclast of all.

She wrote, once, of Ubaldino Peruzzi, whom especially she loathed as the foremost of those attempting to Haussmanize old Italy, that "his dead hand still directs the scrambling haste" with which historic spots are being effaced in order that "a general reign of stucco and shoddy may, as far as in them lies, bring the Athens of Italy to a level with some third-rate American township." Oh, no, she did not love us Americans, nor the things we stood for.

What, then, would she have said to the spectacle of America voting nearly a million dollars to the stricken country; of the nations and the individuals of almost all civilization joining in this great relief? Would she again have written the grim sentence—

“There is no true compassion in that crowd of opposed yet mixing races which, for want of a better word, we call the modern world?”

“That crowd of opposed yet mixing races”—we can take that title to our very selves, to America, and then ask, all the more pointedly, would Ouida have still hated us, had she lived to-day, and seen the relief we send?

It was in her lament upon the death of Felice Cavallotti that she wrote that poignant line, a matter of ten years ago. She hated this age we live in; she was always accusing “the bare, bald, hard temperament” of our generation. She called it “an age which is choked to the throat in suffocating egotisms and vanities, and bound hard and fast in the ligaments of a preposterous and purblind formalism of exclusive self-adoration.” One cannot but wonder if, seeing what compassion our hard age is showing now, she would not have recanted a little.

A LOST MASTERPIECE.

And would she not, finally, have written something that the world would have cherished? It was she, one recalls, who wrote that wonderful appreciation upon Loti’s “Book of Pity and of Death” that was itself so noble a page in the story of human compassion. For all the lower forms of life her pen never tired of serving her passionately and picturesquely. All animal life called to her poignantly; all life that was beaten down and kept in service; the life of the Italian peasants, as she paints it for us time and time again, was like that.

To-day, when thousands upon thousands of just those lives are wrung by disaster that is almost worse than death, surely there would have come from Ouida a note to compel attention.

There must come, too, in these ruined lands, a Risorgimento. Irrevocably gone are countless traces of past centuries; when Messina and Reggio come to be built anew shall the spirit of Ubaldino Peruzzi direct the work, or is it to be the old Italian spirit of art and architecture?

Ah, if Ouida were alive to point the way. For, as she herself never tired of pointing out, it is the Ruskins—the foreigners, in short—who have ever condemned the destruction of the old historic places; the Italians themselves have but too seldom protested. To-day, too, what are the only steamship lines refusing to take supplies from America to Italy free? Not those of the forestieri.

It is as well, from one viewpoint, that Louise de la Ramee died when she did. Old and embittered, she might not have survived such a calamity; she loved the Italian country people far too well. Sometimes one wonders if they know, those country people, just how well she loved them. They cannot read those wonderful pages of hers. * * * But we, who have read them, know that, had she been in her prime when those blows fell on Italy, she would have dipped her pen in blood, in pity, and in death, so that we had been the richer.

And surely, seeing those ships that come to the Italian shores laden with compassion and its proofs, she would have withdrawn that word:

“There is no true compassion in that crowd of oppressed yet mixing races which, for want of a better word, we call the modern world.”

FRENCH PROMPTNESS PLEASED THEM.

A French fleet of a dozen vessels speeding from Toulon to carry succor to the massacred Sicilian cities, apparently strikes the Italians with more significance than all the other swift aid sent the sufferers, for the cable stops in the dolorous recital of the miseries of the scene to explain that the ships sailed as if sped by love.

The word probably is meant to remind Italians that when the French can show solicitude for Sicilians past memories have become very dim, for during more than six hundred years the name Sicilian has been a reminder to the French of about the same sort that Limerick suggests to the Irish, though the causes were far different.

Messina was not the scene of the outbreak of the Sicilian Vespers, but, like every other locality in the island, once the massacre of the French began the Messinians plied their daggers and wrought their vengeance with the characteristic ferocity of a race made up of Arabs, Moslems, Saracens and the hot-blooded southrons generally.

Aside from the Sicilian Vespers, recalling the utter annihilation of an invading race, Sicily and its neighboring shores have other vengeful memories for the French. It was on the shore just across from Messina, in Calabria, that Murat, the "King Joachim" of Napoleonic creation, trusting himself to the loyalty of his former subjects, met the ignominious fate the Mexicans dealt the Archduke Maximilian, when he, too, fancied that his great repute would ingratiate his imperial person to the Spanish residue of Mexico. It was in Sicily that the French legions, irresistible everywhere else, met the few defeats that signalized the early days of the continental conquest.

Both sides, the Sicilians and the French, retain a long memory on the Sicilian Vespers, for when the son of Louis Philippe, the French King, inherited an immense estate in the environs of Palermo, his kinsmen, the ruling Bourbon, were obliged to see that he was secure by covertly installing additional gendarmes in the vicinity of the Duke d'Aumale's dominions.

When in 1867 Verdi, the Homer of composers, daringly selected the massacre as the text of his Exposition opera, "The Sicilian Vespers," the musical directors of the French commission were aghast, but the music served as a reconciling chord instead of reviving the supposed inveterate hate that had rankled for centuries.

SICILY ANOTHER IRELAND.

Set forth truthfully, the "Vesper" massacre had nothing to wound the sensibilities of the French, for the invading princes of Anjou who held the island were not in the least interesting to the French people. They had been the "Cobourgs" of France for generations.

That is, they were bred like rabbits and the stalwart youths seeking their fortunes, principally thrones, came presently to figure as monarchs from Britain to Jerusalem.

They were not a lovely race, the Angevine princes, as Shakespeare pictures them, to say nothing of the chronicles of the centuries of their activities. In Sicily they ruled as interlopers, they modelled their regime exactly on the demon system invented by their compatriots in Britain to extinguish the soul of the Irish.

The Sicilians had borne the same excesses that went on in Ireland with a patience that argued neither spirit nor resentment on their part, when during the spring days of 1282, a scene not unlike the incident that forms the modus of "Virginius," suddenly uncovered the ~~flame~~ long smouldering among gentle and simple.

The Anjou King was not even present when the insurrection broke out. He held the island under subjection through the threatening of forty-two fortresses, the stoutest of them hard by Messina; with these stout castles were scattered about mountain gorges, and soldiery could signal from end to end of the island in case of need. The great nobles who had inherited Sicily from centuries of warrior parents, had been dispossessed of their domains and driven into exile or held in humiliating repression.

Tax gatherers swarmed through the sunny lands exacting the last centessimi, even before the harvests were gathered, for the Angevines in Sicily were like their kinsmen in Britain, constantly in need of money.

Herbert, of Orleans, viceroy of the kingdom for Charles of Anjou,

AN EARLY TRAGEDY.

held Sardanapalian sway in Palermo, then one of the most magnificent capitals of Southern Europe. Guarded by Anjou soldiery, the viceroy and his Angevine minions enforced dissolute sway in the capital, treating the natives with arrogant disdain. It was when the Sicilians seemed degraded beyond even an aspiration for better things that the spark struck. Not far from Palermo near the banks of the sylvan stream Oreto, there stood a chapel dedicated to the Holy Spirit. It was built in a blooming plain and from its porch a wide esplanade wound through exotic shrubbery to the royal palace in the heart of the city.

On Easter Tuesday of the year 1282, the pious citizenry flocked along this vernal highway to and from the Church of the Holy Spirit, It seemed an agreeable diversion for the gallants among the Angevine soldiery to mingle among the pious throngs and "skylark" with the damsels as they wended demurely with their sweethearts to the Easter festivities.

One charming damsel, escorted by her fiance, became the object of over-obtrusive attentions on the part of the Angevine group. The sweet-

heart admonished the soldier to behave himself and let the young girl alone. The captain of the soldiery, hearing the remonstrance, cried out: "The beggarly canaille must be armed, since they dare make answer to a soldier."

Then, as if making search for concealed weapons, the captain seized the damsel and thrust his hand into her neckwear. The horrified girl sunk to the ground in a swoon, but was caught by her sweetheart, who broke out in a frenzied shout: "Let us kill them; kill these French."

This, it will be noted, is almost a rehearsal of the Roman scene where Virginia, attacked by the lictors of Appius Claudius, the father, "caught his wittle up and hid it in his gown."

Armed or unarmed, the mass of the Sicilian youth, who had seen the dastard attack swarmed upon the Angevine soldiery and by sheer force of numbers killed and were killed, until they exterminated everything bearing a French insignia. The legion in sight massacred, the Sicilian youth made for the church to give the signal.

They sounded it vengefully until the tocsin was heard far and near and understood. Every Sicilian tongue then took up the watchword. "Death to the French," and death it was, for never dreaming that the worm could turn, the garrisons were helplessly unprepared for an onset of such a character.

THE SICILIAN DAGGER.

Every Sicilian apparently had a dagger; not a soul was seen anywhere without this weapon. During the long daylight hours the massacre went on, neither palace nor barrack was spared. When the palaces supposed themselves secure from their massive walls, the assailants scaled roofs and came down chimneys, plying the dagger on men, women and children without remorse.

Two thousand dead Angevines were counted when the slayers had time to breathe.

Then they went to work on the traitors who had aided the foreigner, and anyone who couldn't pronounce the word "Ciciri" in the Palermo tone was instantly stabbed.

From Palermo, the "Vesper" signal went like a whirlwind all over

the island. Massacre was the business of the people until every one bearing a French name, or convicted of sympathy with them, was butchered.

The French were extinguished as a dominating power, for though the Anjou princes still claimed right to rule by heritage, other pretenders found their misfortunes an opportunity, and even though the Sicilians rid themselves of the Angevines, they only changed one race of tyrants for another.

Spain laid its hideous hand on the island and for centuries its evil administration made the Angevine interval seem humane and tolerable. To this day whenever the traveler enters memorial edifices, ancient convents, ruined monasteries, the "custode" with many portentous precautions, uncover relics, which they affirm, come from the great Vesper day.

Scores of French "voyageurs" have visited the island to describe its marvels, and in the pages of all of them there are allusions that prove how strangely the memory of the Vespers cling to the consciousness of the two races.

THE IMAGE OF ITALY'S SOUL.

Some of the most eminent of the modern French litterateurs have written fascinating volumes on Sicily, but for all this the island and its people are the least known of any in Europe.

In fact, Sicily only comes into public interest or attention when "brigands, earthquakes or peculiarly atrocious crimes are recounted. All the courts of the Italian kingdom have been unable to bring to justice the murder of the marquis banker slain by the Mafia six years ago.

Even the parliament has been unable to inflict appropriate punishment on a guilty minister of education convicted of carrying on persistent "graft" of the most primitively daring nature during his entire tenure of ministerial responsibility.

When convicted, though he had confessed his guilt by flying from the country, he was triumphantly re-elected to the assembly and again re-elected when again expelled. Though it might seem from the universal monumenting of Garibaldi, that the Sicilians were ardent Italian patriots, they do not in effect consider themselves part of the northern

kingdom and this recalcitrancy has been one of the excruciating problems of the united state.

The Mafia has until recently really governed the electorate and the dagger has been a potent persuader in persuading majorities for outlaws that ought to be in prison or tranquilized by the electric chair!

Though Goethe, after his tour through the Southern lands wrote, "Italy without Sicily leaves no image on the soul, Sicily is the key to all," he pictures Messina and Palermo as the sites above all that made description vain, for it is impossible to give to words the quality that represents the scenic loveliness of a perpetual sunset land.

While every page of ancient history has something to say of Sicily, that land of beauty and delight is least written of by the moderns of all the territories that served as a stage for the portentous dramas embalmed in Grecian and Roman history, to say nothing of mythology. To all, save the archaeologists, it is always a surprise to learn that there are more remnants of Greek temples on the island of Sicily than in all Greece.

In fact, from Sicilian soil may be reconstructed more of the architectural characteristics of all the early nations than the rest of Europe can show.

For Sicily has been in its time the realm of a conquering segment of nearly every race since the disruption of the Roman empire.

EVERY RACE HAS LEFT RELICS.

Even the "Cliff Dwellers" have left their relics among the Tartarean caves of a soil so rich that a harvest a month used to be looked upon as normal. Prehistoric builders are represented by cyclopean structures, foundations of walls raised by Phoenician and Carthaginian conquerors, temples, theatres and fortresses erected by Greek hands, mingle with bridges, aqueducts wrought by Roman engineers.

Byzantine handiwork, mosques and minarets of the Saracens may be studied side by side with the palaces, castles and churches of the Norman-French conquerors.

For many a century Sicily was more a battleground of the nations than Belgium became during the seventeenth and eighteenth centuries.

Every known race was at one time or another master of the island, and every race has left relics of its tenure.

To the Greeks the island was a treasure house for food and supplies; to the Romans it was a land of loot for grasping pro-consuls, as well as a point of vantage for ambitious generals who, holding the territory, could force Rome to either fight or submit, to enterprising rebellion.

During fifteen hundred years the island was looked upon as the prize of the strong-handed. The Moslem and Christian disputed the land for centuries and almost on the site of the chasm that now represents what Messina was, the crusaders from France, Britain and Italy held rendezvous to set sail against the Paynim.

When the Greeks of the mainland saved the west from the incursions of the Persians at Salamis, a battle was fought at Himera, in Sicily, hardly less decisive than the slaughter on the Aegean. For a period the Moslem established the dominion of the African Califs on the Sicilian lands.

THE NORMAN CONQUEST.

One of the most dazzling kingdoms of the middle period between the Roman and the renaissance was that of the Normans, founded by remnants of the French crusaders. Then, in turn, the land was the subject of Suabians, Angevins (French), Aragonese, Catalans, Castillians, Savoyards, Austrians.

From the first settlement of the Ionian Greeks at Naxos, near the slope of Mount Etna, until the French revolution, Sicily was the prey of successive conquerors. Its authentic as well as legendary history reads like an endless volume of romance, ensanguined by wholesale slaughters either by war or earthquakes.

But the land is so lovely, the skies such perpetual panoramas of beauty, the air so clement, the foliage so luxuriant, that the dwellers forgot the ever-impending threat of violent death in the rapturous enjoyment of the satisfaction of the senses. When the destinies of the Grecian patria were at stake, it was in the waters of Syracuse that the frightful naval combat was fought, which Thucydides describes as the greatest sea fight the world has ever known. For centuries the "Siceliots" as the Sicilians were known in contradistinction to other Greeks, became

the cultivated people of the world. Their arts, philosophies, sciences, their poets and historians, ranked with elder Greece.

The magnificence of the Siceliot cities rivalled the utmost that Athens or Corinth was ever accorded. It was in Sicily that the modern Italian tongue arose while the Tuscans were still using the Provençalese or langued'Oc.

In spite of the incomparable greatnesses identified with Sicily, however, it is only when some frightful eruption of a volcano or earthquake destroys cities that the world is reminded of the mighty men and deeds associated with the island.

During the last decade pleasure steamers from ports in this country and Northern Europe have familiarized millions with the coast of Sicily.

The "conducted" touring parties land at the several show cities, from Palermo on the northwest, to Messina in the east, and Syracuse on the south, but there are no such volumes written of the country as depict the wonderlands of the continent.

GRANDEUR OF THE SCENERY.

This is all the more remarkable as the tourists, or the bulk of them, are generally educated folk who set out with their classic handbooks saturated with the mythologies of Greece, know what to seek for when they touch the enchanted land.

A day "off" was considered enough to satisfy the curiosity of the "conducted" tourists at Messina, for, unless the minds were filled with the dramas of a thousand generations, from the land of St. Paul on his way to Athens, to the butcheries of King "Bomba" in 1848, "Messina la nobila" presented to the curious eye only another form of the well built modern Italian city.

In fact, the inexpressible grandeur of the scenery, the vine-terraced mountains, the purple fumes arising from Etna, the enchantingly graceful outlines of the four-mile crescent forming the harbor, so eclipsed all human work, that the city made little impression.

Situated right at the water's edge, with no possible means of sea defence, Messina was always the first point assaulted by the covetous races bent on possessing the key to the Mediterranean. Hence Messina,

though its site is older than any other southern city, was the most modern of the capitals identified with successive races.

Without the relics of antiquity, Messina possessed only the charm of its delicious climate, its gay street life and the bewildering vistas seen from the successive parterres of vine-clad loveliness winding skyward. There had been relics of Grecian, Saracen, Norman and Roman citadels, amphitheatres and what not until the unspeakable Bomba let loose his demoniac soldiery in 1848 to put down the insurrectionary forces bent upon forming a civilized system on the island.

Messina's hundred and fifty thousand people were scattered along the narrow fringe of land between the foot hills and the curving beach, hence the swift destruction that followed the invasion of the "thirty-five feet of water" that is described as rising after the few seconds of shock that tumbled the walls and slaughtered the sleeping victims.

Not long ago a very perfect system of seismographic instruments were set up along the coast to give warning to threatened cities; the mechanism is so ingenious that scientific folk have traveled from far and near to watch its astonishing accuracy, its almost supernatural sensitiveness to the slightest vibration anywhere on the island.

But the experimentation confirms the scientists that the earth is always slightly "atremble," hence the destruction is wrought before warning can be given. But for that matter, as Messina was swaying and disintegrating within the space of a heart throb, warning would have been of small avail. The single edifice in Messina that fixed the attention of the studious for its historic associations and antiquity was the cathedral of La Matrice, founded by Count Roger, the Norman ruler in 1098.

All of the ancient parts of the edifice authentically of the past were the portals of the facade indescribably enriched by carving in stone, and still more celebrated twelfth century mosaics, which were counted unequalled in Italy.

From far and near the pious wended to La Matrice to lay votive offerings on the various altars to propitiate Providence in favor of the sailor folk.

CHAPTER XV

NORTH AMERICAN VOLCANOES.—FAMOUS MOUNT SHASTA.—
NORTHERN ARIZONA.—VOLCANIC GLASS.—CRATERS ON THE
PACIFIC COAST.

A ZONE of mountains extends along the whole western flank of the American continent, from the northern to the southern extremity. This, from Alaska to Terra del Fuego, is associated with volcanoes, though the vents are only locally active, and in the majority of cases the craters are either ruinous or have disappeared. In the extreme north, a volcanic belt extends from the head of Cook's Inlet on the east through Alaska and over the Aleutian Isles towards the district already described. The higher mountains, however, so far as is at present known, are not volcanic—Mount St. Elias, about 18,000 feet, certainly is not.

The same is probably true of its yet more lofty neighbor, Mount Logan, and the other summits near the frontier of British and United States territory; the Alaska coast also, which forms a fringe to this region, seems to be free from volcanoes, and the same is true of South-eastern Alaska and its islands, with the exception of Mount Edgecumbe, an insular volcano which is reported to be a basaltic crater about 2855 feet high, and to have been active in 1796. Eruptions are said to have occurred from Mount Calder and other summits on Prince of Wales Island at a slightly earlier date; but these, as Professor I. C. Russell informs us, are as yet very imperfectly known.

The most conspicuous and best-marked belt begins at Cook's Inlet on the east, and extends through the Alaskan promontory to the Aleutian Islands. It is about a thousand miles long, but generally less than forty miles broad. In fact, every volcano in it which is known to have been active in historic times can be included between two lines on the map of Alaska, twenty-five miles apart. Craters in good preservation are numerous, and active vents not few, one of which has been already noticed. They occur

either close to the sea on the southern border of the mainland or on islands.

To this statement as to the geographical distribution one exception is known ; some small cones, also of basalt, occur near St. Michael on the coast of Behring Sea, about seventy miles north of the mouth of the Yukon River ; but there may be others, for at present not much of Alaska has been carefully investigated by qualified observers. On Copper River, some two hundred miles to the northeast of Cook's Inlet, and thus apparently insulated from the Aleutian belt, rises Mount Wrangel, a lofty volcano, which was in eruption in 1819 and is still steaming, and others of the neighboring mountains may have the same origin.

On the western shore also of this inlet are two fine volcanic peaks, Redoute and Iliamna, reported to be about 11,000 and 12,000 feet high. The latter is generally steaming, and a few years ago discharged such a quantity of dust and lapilli that the forests were killed over hundreds of square miles on the adjacent lowlands.

VOLCANOES OF ALASKA.

From this district to Central America no active vents exist, though they were once plentiful. In the Canadian territory to the south and east of United States Alaska very little is at present known of its volcanic history. There are lava sheets about the Fraser River of enormous extent, but Dr. G. M. Dawson did not discover here any distinct traces of craters, so that very probably this portion of the American continent may be compared with the northern side of the Atlantic basin, where discharges anciently occurred from Antrim at least as far as Iceland, but now continue only in the latter region.

The Columbia lavas, vast sheets of basalt, have been already mentioned ; but here, as in the Fraser River district, cinder cones and craters are wanting, and the eruptions probably date from about the middle of the Tertiary era. They lie to the east of the Cascade Mountains, in which volcanoes have certainly existed, but whether any retain their craters does not seem to be as yet ascertained. There is a tradition that Mount Baker, a fine peak to the west of

the main chain and in the northern part of the district (near Puget Sound), broke out in 1843, but on this point Professor Russell is doubtful.

Mount Rainier, however, a superb peak, not only from its elevation, 14,525 feet, but also because it rises practically from sea-level, still emits some steam. The highest part is a cone built up within the shattered ring of a much older crater, and the materials appear to be basaltic. Mount St. Helens (9,750 feet), also detached from the main mass, is said to have been in eruption in 1841-42, and fumaroles still exist on the slopes. Mount Adams (9,570 feet), farther south and rather east of the main range, apparently retains a crater.

On the crest of the Cascade Mountains, in Northwestern Oregon, Mount Hood rises to a height of 11,225 feet, and is noted for the beauty of its outline. Portions only of the wall of its summit crater now remain, but there are still fumaroles at considerable elevations on the northeast and the south sides. Mount Jefferson (10,200 feet) and the Three Sisters, a little farther south, in the Cascade range, are the sites of ancient volcanoes; but their craters apparently have perished, and to the south of these come others of less elevation, which for the most part retain craters either at their summits or on their flanks, the most important of them being Crater Lake or Mount Mazama, which has been already described.

SUMMIT CRATER OF SHASTA.

Yet farther south comes the noted mass of Mount Shasta, rising to a height of 14,350 feet. The summit crater is ruinous, and the slopes are scarred with ravines; but lava streams have flowed down its flank since the Glacial epoch, and a distinct subsidiary crater remains on a lower summit called Shastina. Farther south comes a volcanic district named Lassen's Peak from its principal summit, which rises to an elevation of 10,437 feet. This is crossed from northwest to southeast by a belt of volcanic cones about fifty miles long by twenty-five miles wide; one of them, Cinder Cone by name, being remarkably well preserved.

The crater, as illustrated by Professor Russell, is a double one, and there were two distinct periods of eruption. In the earlier a quantity of ash was ejected and the cinder cone itself was formed. Then there was a pause long enough to allow ten feet of diatomaceous earth to accumulate on the bed of an adjacent lake, and after that came the quiet effusion of a large sheet of lava.

East of the Sierra Nevada, on the area once occupied by a great sheet of water now spoken of as Lake Lahontan, are two ancient craters filled with alkaline water. The greater, which has an area of about 268 acres, only rises some eighty feet above the level of the surrounding country, so that it resembles, though on a larger scale, such a crater as the Pulvermaar in the Eifel. Geological evidence shows that these were active during the existence of Lake Lahontan, and that before they ceased it had already begun to dry up.

POURING OUT LAVA STREAMS.

In the Mono valley, also east of the Sierra Nevada, but farther south, and near to the lake of the same name, are a number of craters, some not much elevated above the surrounding country, but others rising to over 2000 feet, with lava streams and fumaroles. The materials apparently consist of basalts and varieties of andesite; but the Mono craters, as the line of higher cones is called, have ejected rhyolite and even obsidian. Professor Russell remarks that those cones (some of which have lost their craters), though forming an isolated group, are really a portion of a much more extended series of recent eruptions, which follow the general course of the great belt of branching faults by which the eastern face of the Sierra Nevada has been determined.

The fact that, as a rule, the central cones are the less perfectly preserved and are the older, shows that "the volcanic energy early in the history of the range evidently found an avenue of escape where [they] now stand, and when the conduits of these craters became clogged newer craters were formed, both to the north and south, along the same line or belt of fracture."

To the west of the Wahsatch Mountains, in the inland basin of Utah, and on the area once occupied by the great sheet of water designated Lake Bonneville, are the Ice Spring Craters, a group of low craters, three of which are very well defined, though they are breached by streams of basaltic lava, which covers an area of over twelve square miles. Other craters occur in the district, some being older and some newer than Lake Bonneville, while others were active during its existence.

In northern Arizona the San Francisco Mountains are volcanic. The higher summits, which rise to a mean elevation of 12,562 feet above the sea and about 5700 above the general level of the surrounding table-land, consists largely of trachytic lavas and have lost their craters; but around them are numerous small craters of basaltic scoria, which often are well preserved and are associated with flows of the same rock. Some of these have been breached by the lava, which has welled up in their interior and has escaped exactly as was described by Scrope in his book on *The Volcanoes of Central France*. In one, however, a lake is sheltered.

FAR-FAMED YELLOWSTONE PARK.

Just east of the crest of the Rocky Mountains, and in the north-west corner of the State of Wyoming, is the far-famed volcanic district of the Yellowstone Park and its neighborhood. Craters apparently are not common in this region, but the great flows of obsidian attracted much attention from geologists. This volcanic glass is associated with pumice, the rocks generally being trachytes, usually rich in silica. The vents are now extinct, unless a mud volcano be regarded as an exception; but the hot springs and geysers to which the Park owes its world-wide fame show that a high temperature still prevails, probably at no great depth below the surface.

The vast flows of basalt in the valleys draining to the Snake River in Idaho, to which reference has already been made, are on the western slope of the Rocky Mountains, but at no very great distance from the Yellowstone Park. Also east of the Rocky Mountains, in the State of Colorado, are several

very large cones and flows of basalt, while to the south of Pucho the bold summits of the Spanish Peaks, which rise respectively to heights of 12,720 and 13,620 feet above the sea, are ancient volcanoes ; but in all these the craters seem to have been destroyed. The materials are described as trachytes, some varieties approaching rhyolite.

Farther south, however, in the State of New Mexico, are several extinct volcanoes, some of which retain their craters in good preservation. The materials, so far as described, are basalt. Mount Taylor (11,390 feet) also is the centre of a volcanic district. Its crater has perished, but these remain on some of the smaller neighboring cones. The rock apparently is basalt.

The long peninsula of Lower California may be regarded as a prolongation of the chain of the Sierra Nevada. It also contains many extinct volcanoes, which, however, are at present but imperfectly known. Towards the north, according to Professor Russell, Mount Santa Catalina rises to a height of some 10,000 feet, and about the middle is a group of volcanic peaks known as the Tres Virgines, the highest of which is said to be 7250 feet. In this group an eruption occurred in 1857, and since then steam has been ejected, sometimes in great quantity.

THREE MOUNTAIN CHAINS.

Those described above, as Professor Russell remarks, are only some of the most striking instances among the hundreds of lava-flows and craters within the United States ; but it will be noticed that the great majority are associated with the second one of the three mountain chains which form the western flank of the North American continent, the huge eastern mass of the Rocky Mountains being almost entirely, and the smaller western one of the Coast Range being wholly, free from volcanoes of recent date. The Sierra Madre in Mexico, which may be regarded as a prolongation of the Rocky Mountains, appears to exhibit no signs of volcanic action.

Thus a very considerable space separates the volcanoes of the part of Mexico which lies south of the tropic of Cancer, a region

of great activity even in the present day, from those of which we have been speaking. The former also appear not to lie, as usual, along a belt parallel with the western coast, but to be rather irregularly distributed over one, about 150 miles in breadth, which extends from sea to sea in a general direction from W. N. W. to E. N. E. for not much less than 600 miles.

All the volcanoes in Mexico which are still active (ten in number according to Reclus) lie south of latitude 22° . The most northerly of them is Ceboruco (about 7140 feet) on the Pacific coast, the centre of a group of craters, which was in eruption in 1870, and has continued steaming ever since. Farther south, near the same coast, is Colima, which has frequently been active. In 1885, the dust from it was carried to the northeast for a distance of 280 miles.

A CELEBRATED VOLCANO.

Proceeding eastwards, and slightly to the south, we come to Jorullo, the eruption of which, ever since the days of Humboldt, has figured so largely in geological text books. This for many years was quoted as an example which very strongly supported the elevation theory of volcanic cones. It was asserted that here a tract of land from three to four miles in extent had almost suddenly swelled up like a bladder, while cones were built by discharges from its surface and at its sides. This happened on the night of September 29, 1759; but, as has been frequently shown, the evidence for this remarkable phenomenon is quite untrustworthy.

Proceeding east, the volcanoes became more lofty. Xinantecatl, some forty miles southwest of the city of Mexico, crowned by two crater-lakes, rises to about 15,000 feet; but east of that city are two giants, Ixtacihuatl to the north, and Popocatepetl to the south. The former, which, however, has lost its crater, is hardly less, perhaps more, than 16,500 feet; but Popocatepetl is about 1200 feet more than this, and terminates in a crater from which a little steam issues. The lower part of the mountain consists of basalt, but the great cone is mostly composed of andesite and its summit is described as trachyte.

Yet farther to the east come Cofre de Perote and Orizaba, which also lie on a north and south line; the former, which is composed of hornblende andesite, has lost its crater and is only 13,552 feet high; but its companion is the highest volcanic summit on the northern continent. The exact measurement is uncertain, but it cannot be much, if at all, less than 18,000 feet. On the summit are three craters in good preservation, and the flanks of the mountain are studded with small cones. Its last eruption is said to have occurred in the eighteenth century.

Finally, on the eastern coast is Tuxtla, reported to be a little less than 5000 feet high, which is active from time to time. A terrible eruption occurred, after a pause of nearly one hundred and twenty years, in March, 1793. A series of violent explosions considerably reduced the height of the mountain and scattered ashes over a large area. The fine dust was borne by the wind about 150 miles to the northwest, and the same distance to the southwest. This fact suggests that, as happened to a less extent in an eruption of Cotopaxi, part of the dust was shot up into a region where an upper stratum of air was moving in a different direction from the lower one.

EXPLOSION AFTER LONG REPOSE.

Still in Mexico, but considerably to the south of the belt described above, and on the shore of the Pacific, is Chacahua, an extinct crater, while to the east of it is Pochutla, a volcano which, after a very long period of repose, exploded in 1870.

From Guatemala to Costa Rica is a zone marked by great volcanic activity, which follows the line of the Pacific coast. Some of the cones on this rise to elevations considerably above 10,000 feet, but the majority do not exceed 8000. In Guatemala, according to a list given by Professor Russell, there are two active volcanoes, four quiescent, and fifteen extinct. Among the last-named is Tajumulco, which lays claim, though probably without warrant, to an altitude of 18,317 feet.

In San Salvador five are active, three quiescent, and the same number extinct. Honduras, which lies chiefly to the east of

the mountain axis, is without an active volcano, but has two quiescent and three extinct. Nicaragua contains four active, eight quiescent, five extinct, while in Costa Rica one only can be called active, and its last eruption was as long ago as 1726, while two are quiescent and six extinct. Lastly, at the northern part of the Isthmus of Panama are three mountains of volcanic origin, two of them over 11,000 feet high, but it is doubtful whether any one retains a remnant of a crater.

Three of the volcanoes in the above-named list are especially interesting, because, like Monte Nuovo, the history of their actual birth is recorded. Two of these are in San Salvador, the third in Nicaragua. Of the former, Izalco, now rising about 3000 feet above the surrounding country and 5000 feet above the sea-level, began to be formed in the year 1770. It covers what previously was a fine cattle farm. "The occupants on this estate were alarmed by subterranean noises and shocks of earthquakes about the end of 1769, which continued to increase in loudness and strength until the twenty-third of the February following, when the earth opened about half a mile from the dwellings on the estate, sending out lava, accompanied by fire and smoke."

HOW THE CONE WAS BUILT UP.

The eruption thus begun went on continuously, lava sometimes being ejected, but at others only ashes and volcanic bombs, and thus the cone has been built up to its present height. No lava has been discharged for many years, but ashes and dust, mingled with steam, are constantly ejected. There are three craters, the central one being the largest and most active. Acid vapors also are emitted from fumaroles. Lake Ilopango, which possibly occupies an ancient crater, also in San Salvador, witnessed the beginning of a volcano as lately as the year 1880.

A violent earthquake in 1879 was accompanied by a rising of steam from the lake, and was followed by a steady fall in the level of its waters, amounting to about thirty-five feet. - Then, during the night of January 20, 1880, the surface of the lake was again agitated, and the next morning a pile of rocks was observed in

the centre, from which rose a column of vapor. The eruption lasted for more than a month, sulphurous vapors were emitted copiously, the fish in the lake were killed, and a cone was ultimately formed about 160 feet above the water, but rising from a depth of some 600 feet.

A new volcano broke out on April 11, 1850, in Nicaragua, in a district called the Plain of Leon. This is studded with cones, of which one at least is active. The commencement of the eruption was not carefully observed, but the outbreak occurred near the base of an extinct crater called Las Pilas. It began with a copious discharge of lava.

This ceased on the fourteenth of the month, and was succeeded by a different phase of action, namely, a series of paroxysms lasting about three minutes, with intervals of about the same length. By these, steam, ashes, and red-hot bombs were shot up to a height of several hundred feet, accompanied, it is said, by outbursts of flame. Thus in the course of a week a cone was built up to a height of from a hundred and fifty to two hundred feet, after which the action became much more intermittent.

THREE SOUTH AMERICAN PEAKS.

Among the older summits of Central America it may suffice to mention three, all of which are lofty mountains. Volcan de Agua, 12,213 feet, at the time of the Spanish invasion was a crater-lake. In the year 1541, after an earthquake, the wall of the crater gave way on the northeastern side and the water escaped, doing great damage as it rushed down the slope of the mountain. Fuego, to the east, with its group of three volcanic cones, the highest of which attains to 13,943 feet, was often active in the sixteenth and seventeenth centuries, and probably for some long time previously; but since then eruptions have been less frequent, though one occurred as late as 1860, and steam still issues from the crater.

But the most noted of all is Coseguina, for it was the scene of a frightful eruption in the year 1835. So far as is known, this, like the famous awakening of Vesuvius in the year 79, put an

end is a long period of complete repose. It began on the morning of January 20th, when several loud detonations were heard, followed by the ejection of a cloud of inky smoke, through which "darted tongues of flame resembling lightning." The cloud spread gradually outward, obscuring the sun, while fine dust fell from it like rain. This went on for two days, the sand falling more and more thickly and the explosions becoming louder and louder.

On the third day they reached a maximum and the darkness became intense. The quantity of material that fell was so great that for leagues around people actually deserted their houses, fearing lest their roofs might be crushed in. At Leon, more than a hundred miles away, the dust lay several inches deep, and it was carried to Jamaica, Vera Cruz and Santa Fé de Bogota, over an area of 1500 miles in diameter. The sea also was covered with floating masses of pumice for a distance of some fifty leagues.

FOUR MILES IN DIAMETER.

During the eruption the height of the cone was considerably reduced, but to what extent is not certainly known; probably by at least one half, for it is now a crater four miles in diameter and only 3600 feet above the sea. Many of the phenomena during this outbreak closely agree with those associated with the first eruption of Vesuvius and that of Krakatoa already described.

The Isthmus of Panama, though its hills in places are comparatively low and without volcanic cones, links together the great mountain chains of North and South America. But that of the Andes, which extends along the whole western flank of the latter, is rather less complicated in structure than the system of the former country. It is a single chain, consisting partly of sedimentary, partly of igneous rocks, old and new, both crystalline and volcanic. The sedimentaries and the older igneous form the lower part of the great mountain wall, and the volcanoes, generally speaking, rise more nearly from its crest than from its flanks.

They are not, however, continuous along the whole chain, but

form three principal groups—those of Colombia and Ecuador in the north, those of Bolivia in the centre, and those of Chili in the south. About sixty craters are still active; those which are extinct and more or less ruined may be counted by hundreds. The first group, in the more northern part, consists of three principal ranges, of which the eastern one branches out at last into the great mountains which runs roughly parallel with the border of the Caribbean Sea.

The western range is less elevated than the others, at any rate in its more northern part; the central, on which the volcanoes are chiefly situated, supports many lofty peaks. Of these Mesa de Herveo, 18,340 feet, retains its ancient crater; Ruiz, 17,189 feet; Tolima, 18,392 feet; and Huila, 18,701, all show some signs of life. An eruption occurred at Puracé, 15,425 feet, in 1849, when the torrents of mud caused by the rapid melting of the snow caused much devastation. Extinct volcanoes are also frequent. In the eastern chain no vents are mentioned as active.

FIERY SUMMITS OF ECUADOR.

Passing into Ecuador, the volcanic summits, according to Mr. Whymper, are grouped along two roughly parallel lines. On the western, Cotacachi, Pichincha, Corazon, Illiniza, Carihuairazo, and Chimborazo are the most important; on the eastern, Cayambe, Antisana, Sincholagua, Cotopaxi, Altar, and Sangai. Of these the majority have lost their craters, including Chimborazo. Altar retains one, so does Pichincha, which apparently is hardly extinct, while Sangai and Cotopaxi, which has been already described, are still active.

It may suffice to say that the specimens brought back by Mr. Whymper were almost without exception varieties of andesite, several of them containing hypersthene. Antisana, however, also furnished a pitchstone. The volcanic cones, according to Reiss and Wolf, continue for some distance to the south of those which have been mentioned.

In the Peruvian and Bolivian Andes we find the second linear group of craters. The same arrangement in parallel lines

to continue, and the highest summit, Hauscan, is said to overtop Chimborazo by rather more than 1300 feet. Volcanic cones are most frequent in the southern part of the western range, where they set in again some 1200 miles from those of Ecuador. Few, however, are mentioned as active in historic times; among them Ubinas, Omate, Candarave (18,964 feet), are enumerated by Reclus. But among the extinct volcanoes some also rise to great heights, such as Sara-Sara, Achatayhua, Coro Puna, Ampato, Misti, and Chachani, all of which exceed 13,000 feet, the last reaching 19,767 feet and Misti 18,504 feet.

This volcanic group continues into Bolivia, and there are some active craters, especially near Lake Titicaca. Presumably the higher peaks of this country, five of which are enumerated as over 21,000 feet, and the highest, Illimani, reaching 22,350 feet, are volcanic, and the last is said to smoke constantly. Altogether, sixteen craters are asserted to be active in this second group of Andes volcanoes, of which, at present, our knowledge is rather imperfect.

LONG CEASED TO BE ACTIVE.

Passing on to the third group, the volcanoes of Chili, we find these numerous, though, for the most part, they have long ceased to be active. In the northern part, however, two at least, Llullailaco (17,061 feet) and Dona Inez are still at work. In the middle are the highest summits—Aconagua, 22,867 feet; Cerro del Mercedario, 22,302 feet; Tupungato, 19,269 feet; San José, 20,000 feet; and Maipo, 17,657 feet. Of these, Aconagua has entirely lost its crater, and Tupungato retains due distinctive trace of it, but one or two vents are still active; one about 13,000 feet high, lying some twenty miles to the southwest of Tupungato. In this part also, according to Mr. FitzGerald, the Andes consist of two ranges, of which the western is the watershed; the other supports the highest peaks. There is also a third and eastern range, but this is separated from the main chain by a valley only about 4000 feet above sea level.

The rocks brought back by Messrs. FitzGerald and Vines are mostly andesites, the actual summits of Aconagua and Tupun-

gato being the hornblende-bearing variety of that rock, though a rhyolite or dacite was obtained on the flank of the latter mountain. The volcanic line does not completely come to an end with Chili, for Corcovado (7510 feet) in the Patagonian Andes is a volcano, but though there may be some extinct cones yet farther south, the active vents are not continued to Cape Horn.

CHAPTER XVI

RIDGE OF PANAMA AND THE ANDES.—THE GREAT CANYON.—
CALIFORNIA AND UTAH.—YELLOWSTONE PARK.—MEXICO
AND SOUTH AMERICA.

IN no point is there a more remarkable contrast between the physical structure of Eastern and Western America than in the absence of volcanic phenomena in the former and their prodigious development in the latter. The great valley of the Mississippi and its tributaries forms the dividing territory between the volcanic and non-volcanic areas; so that on crossing the high ridges in which the western tributaries of America's greatest river have their sources, and to which the name of the "Rocky Mountains" more properly belongs, we find ourselves in a region which, throughout the later Tertiary times down almost to the present day, has been the scene of volcanic operations on the grandest scale; where lava-floods have been poured over the country through thousands of square miles, and where volcanic cones, vying in magnitude with those of Etna, Vesuvius, or Hecla, have established themselves.

This region, generally known as "The Great Basin," is bounded on the west by the "Pacific Range" of mountains, and includes portions of New Mexico, Arizona, California, Nevada, Utah, Colorado, Idaho, Oregon, Wyoming, Montana and Washington. To the south it passes into the mountainous region of Mexico, also highly volcanic; and thence into the ridge of Panama and the Andes. It cannot be questioned but that the volcanic nature of the Great Basin is due to the same causes which have originated the volcanic outbursts of the Andes; but, from whatever cause, the volcanic forces have here entered upon their secondary or moribund stage.

In the Yellowstone Valley, geysers, hot springs and fumaroles give evidence of this condition. In other districts the lava streams are so fresh and unweathered as to suggest that they had been

erupted only a few hundred years ago ; but no active vent or crater is to be found over the whole of this wide region. A few special districts only can here be selected by way of illustration of its special features in connection with its volcanic history.

This tract, which is drained by the Colorado river and its tributaries, is bounded on the north by the Wahsatch range, and extends eastward to the base of the Sierra Nevada. Round its margin extensive volcanic tracts are to be found, with numerous peaks and truncated cones—the ancient craters of eruption—of which Mount San Francisco is the culminating eminence.

South of the Wahsatch, and occupying the high plateaux of Utah, enormous masses of volcanic products have been spread over an area of 9000 square miles, attaining a thickness of between 3000 and 4000 feet. The earlier of these great lava-floods appear to have been trachytic, but the later basaltic ; and in the opinion of Captain Dutton, who has described them, they range in point of time from the Middle Tertiary (Miocene) down to comparatively recent times.

HIGH LEVELS IN UTAH.

To the south of the high plateaux of Utah are many minor volcanic mountains, now extinct ; and as we descend towards the Grand Canon of Colorado we find numerous cinder cones scattered about at intervals near the cliffs. Extensive lava fields, surmounted by cinder cones, occupy the plateau on the western side of the Grand Canon ; and, according to Dutton, the great sheets of basaltic lava, of very recent age, which occupy many hundred square miles of desert, have had their sources in these cones of eruption.

Crossing to the east of the Grand Canon, we find other lava floods poured over the country at intervals, surmounted by San Francisco—a volcanic mountain of the first magnitude—which reaches an elevation, according to Wheeler, of 12,562 feet above the ocean. It has long been extinct, and its summit and flanks are covered with snow fields and glaciers. Other parts of Arizona are overspread by sheets of basaltic lava, through which old

"necks" of eruption, formed of more solid lava than the sheets, rise occasionally above the surface, and are prominent features in the landscape.

Further to the eastward in New Mexico, and near the margin of the volcanic region, is another volcanic mountain little less lofty than San Francisco, called Mount Taylor, which, according to Dutton, rises to an elevation of 11,390 feet above the ocean, and 8200 feet above the general level of the surrounding plateau of lava. This mountain forms the culminating point of a wide volcanic tract, over which are distributed numberless vents of eruption. Scores of such vents—generally cinder cones—are visible in every part of the plateau, and always in a more or less dilapidated condition. Mount Taylor is a volcano, with a central pipe terminating in a large crater, the wall of which was broken down on the east side in the later stage of its history.

VOLCANIC RANGES.

Proceeding westward into California, we are again confronted with volcanic phenomena on a stupendous scale. The coast range of mountains, which branches off from the Sierra Nevada at Mount Pinos, on the south, is terminated near the northern extremity of the State by a very lofty mountain of volcanic origin, called Mount Shasta, which attains an elevation of 14,511 feet. This mountain was first ascended by Clarence King in 1870, and although forming, as it were, a portion of the Pacific Coast Range, it really rises from the plain in solitary grandeur, its summit covered by snow, and originating several fine glaciers.

The summit of Mount Shasta is a nearly perfect cone, but from its northwest side there juts out a large crater-cone just below the snow line, between which and the main mass of the mountain there exists a deep depression filled with glacier ice. This secondary crater-cone has been named Mount Shastina, and round its inner side the stream of glacier ice winds itself, sometimes surmounting the rim of the crater, and shooting down masses of ice into the great cauldron.

The length of this glacier is about three miles, and its breadth

about 4000 feet. Another very lofty volcanic mountain is Mount Rainier, in the Washington territory, consisting of three peaks of which the eastern possesses a crater very perfect throughout its entire circumference. This mountain appears to be formed mainly of trachytic matter. Proceeding further north into British territory, several volcanic mountains near the Pacific coast are said to exhibit evidence of activity.

Of these may be mentioned Mount Edgecombe, Mount Fairweather, which rises to a height of 14,932 feet; and Mount St. Elias, just within the divisional line between British and Russian territory, and reaching an altitude of 16,860 feet. This, the loftiest of all of the volcanoes of the North American continent, except those of Mexico, may be considered as the connecting link in the volcanic chain between the continent and the Aleutian Islands.

LAKES AND THEIR ORIGIN.

Returning to Utah we are brought into contact with phenomena of special interest, owing to the inter-relations of volcanic and lacustrine conditions which once prevailed over large tracts of that territory. The present Great Salt Lake, and the smaller neighboring lakes, those called Utah and Sevier, are but remnants of an originally far greater expanse of inland water, the boundaries of which have been traced out by Mr. C. K. Gilbert, and described under the name of Lake Bonneville.

The waters of this lake appear to have reached their highest level at the maximum cold of the Post Pliocene period, when the glaciers descended to its margin, and large streams of glacier water were poured into it. Eruptions of basaltic lava from successive craters appear to have gone on before, during, and after the lacustrine epoch; and the drying up of the waters over the greater extent of their original area, now converted into the Sevier Desert, and their concentration into their present comparatively narrow basins, appears to have proceeded *pari passu* with the gradual extinction of the volcanic outbursts.

Two successive epochs of eruption of basalt appears to have been clearly established—an earlier one of the "Provo Age,"

when the lava was extruded from the Tabernacle craters, and a later epoch, when the eruptions took place from the Ice Spring craters. The oldest volcanic rock appears to be rhyolite, which peers up in two small hills almost smothered beneath the lake deposits. Its eruption was long anterior to the lake period.

On the other hand, the cessation of the eruptions of the later basaltic sheets is evidently an event of such recent date that Mr. Gilbert is led to look forward to their resumption at some future, but not distant, epoch. As he truly observes, we are not to infer that, because the outward manifestations of volcanic action have ceased, the internal causes of those manifestations have passed away. These are still in operation, and must make themselves felt when the internal forces have recovered their exhausted energies ; but perhaps not to the same extent as before.

COUNTRY BORDERING SNAKE RIVER.

The tract of country bordering the Snake River in Idaho and Washington is remarkable for the vast sheets of plateau-basalt with which it is overspread, extending sometimes in one great flood farther than the eye can reach, and what is still more remarkable, they are often unaccompanied by any visible craters or vents of eruption. In Oregon the plateau-basalt is at least 2000 feet in thickness, and where traversed by the Columbia River it reaches a thickness of about 3000 feet.

The Snake and Columbia rivers are lined by walls of volcanic rock, basaltic above, trachytic below, for a distance of, in the former, one hundred, in the latter, two hundred, miles. Captain Dutton, in describing the High Plateau of Utah, observes that the lavas appear to have welled up in mighty floods without any of that explosive violence generally characteristic of volcanic action. This extravasated matter has spread over wide fields, deluging the surrounding country like a tide in a bay, and overflowing all inequalities. Here also we have evidence of older volcanic cones buried beneath seas of lava subsequently extruded.

The absence or rarity, of volcanic craters or cones of eruption in the neighborhood of these great sheets has led American geolo-

gists to the conclusion that the lavas were in many cases extruded from fissures in the earth's crust rather than from ordinary craters. This view is also urged by Sir A. Geikie, who visited the Utah region of the Snake River in 1880, and has vividly described the impression produced by the sight of these vast fields of basaltic lava.

He says, " We found that the older trachytic lavas of the hills had been deeply trenched by the lateral valleys and that all these valleys had a floor of black basalt that had been poured out as the last of the molten material from the now extinct volcanoes. There were no visible cones or vents from which these floods of basalt could have proceeded. We rode for hours by the margin of a vast plain of basalt stretching southward and westward as far as the eye could reach. I realized the truth of an assertion made first by Richthofen, that our modern volcanoes, such as Vesuvius and *Ætna*, present us with by no means the grandest type of volcanic action, but rather belong to a time of failing activity. There have been periods of tremendous volcanic energy, when instead of escaping from a local vent, like a Vesuvian cone, the lava has found its way to the surface by innumerable fissures opened for it in the solid crust of the globe over thousands of square miles."

HISTORY OF THE ERUPTIONS.

The general succession of volcanic events throughout the region of Western America appears to have been somewhat as follows :

The earliest volcanic eruptions occurred in the later Eocene epoch and were continued into the succeeding Miocene stage. These consisted of rocks moderately rich in silica, and are grouped under the heads of prophyte and andesite. To these succeeded during the Pliocene epoch still more highly silicated rocks of trachytic type, consisting of sanidine and oligoclase trachytes.

Then came eruptions of rhyolite during the later Pliocene and Pleistocene epoch ; and lastly, after a period of cessation, during which the rocks just described were greatly eroded, came

the great eruptions of basaltic lava, deluging the plains, winding round the cones or plateaux of the older lavas, descending into the river valleys and flooding the lake beds, issuing from both vents and fissures, and continuing intermittently down almost into the present day—certainly into the period of man's appearance on the scene.

Thus the volcanic history of Western America corresponds remarkably to that of the European regions with which we have previously dealt, both as regards the succession of the various lavas and the epochs of their eruption.

The geysers and hot springs of the Yellowstone Park, like those in Iceland and New Zealand, are special manifestations of volcanic action, generally in its secondary or moribund stage. The geysers of the Yellowstone occur on a grand scale; the eruptions are frequent, and the water is projected into the air to a height of over 200 feet. Most of these are intermittent, like the remarkable one known as Old Faithful, the Castle Geyser, and the Giantess Geyser described by Dr. Hayden, which ejects the water to a height of 250 feet.

TINTS OF RED AND YELLOW.

The geyser waters hold large quantities of silica and sulphur in solution, owing to their high temperature under great pressure, and these minerals are precipitated upon the cooling of the waters in the air, and form circular basins, often gorgeously tinted with red and yellow colors.

In the great Pacific Ocean, the Islands may be referred to two classes, distinguished by their elevation into high and low. The latter class appear to be entirely of modern formation, the product of that accumulation of coral reefs which Flinders and others have described in so interesting a manner. The high islands, on the contrary, are chiefly volcanic, though in the Friendly and Marquesa Islands primitive rocks occur, and in the Waohoo porphyry and amygdaloid.

The Mariana or Ladrone Islands constitute a sort of mountain chain, consisting of a line of active volcanoes, especially

towards their north, which is parallel to that of the Philippine group, whereas the islands that lie detached in the middle of the basin, of which these two groups are the boundaries, seem for the most part to be extinguished.

Mr. Ellis, a missionary, has given in a narrative of a Tour Through the Hawaii Islands a most detailed account of the active volcano of Hawaii.

The plain over which their way to the mountain lay was a vast waste of ancient lava, which he thus describes:—"The tract of lava resembled in appearance an inland sea, bounded by distant mountains. Once it had certainly been in a fluid state, but appeared as if it had become suddenly petrified, or turned into a glassy stone, while its agitated billows were rolling to and fro. Not only were the large swells and hollows distinctly marked, but in many places the surface of these billows was covered by a smaller ripple, like that observed on the surface of the sea at the springing up of a breeze, or the passing currents of air, which produce what the sailors call a cats-paw.

EDGE OF A STEEP PRECIPICE.

"About 2 P. M. the crater of Kilauea suddenly burst upon our view. We expected to have seen a mountain with a broad base and rough, indented sides, composed of loose slags, or hardened streams of lava, and whose summit would have presented a rugged wall of scoria, forming the rim of a mighty cauldron. But instead of this, we found ourselves on the edge of a steep precipice, with a vast plain before us fifteen or sixteen miles in circumference, and sunk from two hundred to four hundred feet below its original level. The surface of this plain was uneven, and strewed over with huge stones and volcanic rock, and in the center of it was the great crater, at the distance of a mile and a half from the place where we were standing. We walked on to the north end of the ridge, where, the precipice being less steep, a descent to the plain below seemed practicable. With all our care, we did not reach the bottom without several falls and slight bruises.

"After walking some distance over the sunken plain, which

in several places sounded hollow under our feet, we at length came to the edge of the great crater, where a spectacle sublime, and even appalling, presented itself before us. Immediately before us yawned an immense gulf, in the form of a crescent, about two miles in length, from N. E. to S. W., nearly a mile in width, and apparently eight hundred feet deep. The bottom was covered with lava, and the S. W. and northern parts of it were one vast flood of burning matter, in a state of terrific ebullition, rolling to and fro its 'fiery surge' and flaming billows.

A BURNING LAKE.

"Fifty-one conical islands of varied form and size, containing so many craters, rose either round the edge, or from the surface of the burning lake; twenty-two constantly emitted columns of grey smoke, or pyramids of brilliant flame; and several of these at the same time vomited from their ignited mouths streams of lava, which rolled in blazing torrents down their black indented sides, into the boiling mass below. The existence of these conical craters led us to conclude that the boiling cauldron of lava before us did not form the focus of the volcano; that this mass of melted lava was comparatively shallow; and that the basin in which it was contained was separated by a stratum of solid matter from the great volcanic abyss, which constantly poured out its melted contents through these numerous craters into this upper reservoir.

"The sides of the gulch before us, although composed of different strata of ancient lava, were perpendicular for about four hundred feet, and rose from a wide horizontal ledge of solid black lava of irregular breadth, but extending completely round, beneath this ledge, the sides sloped gradually towards the burning lake, which was, as nearly as we could judge, three hundred or four hundred feet lower. It was evident that the large crater had been recently filled with liquid lava up to this black ledge, and had, by some subterraneous canal, emptied itself into the sea or under the low land on the shore.

"The grey, and in some places apparently calcined sides of the great crater before us—the fissures which intersected the sur-

face of the plain on which we were standing—the long banks of sulphur on the opposite side of the abyss—the vigorous action of the numerous small craters on its borders—the dense columns of vapor and smoke that rose at the N. and S. end of the plain—together with the ridge of steep rocks by which it was surrounded, rising probably in some places three or four hundred feet in a perpendicular height, presented an immense volcanic panorama, the effect of which was greatly augmented by the constant roaring of the vast furnaces below.

“The natives still persist in believing, that the conical craters of the mountains are the houses of their gods, where they frequently amuse themselves by playing at Konané (a game like draughts); that the roaring of the furnaces and the crackling of the flames are the music of their dance, and that the red flaming surge is the surf in which they play, sportively swimming on the rolling wave. Some of their legends may remind us of those that prevailed among the Greeks.

CURIOUS OLD LEGEND.

“Thus one of their kings, who had offended Pélé, the principal goddess of the volcano, is pursued by her to the shore, where leaping into a canoe he paddles out to sea. Pélé, perceiving his escape, hurls after him huge stones and fragments of rock, which fall thickly around, but do not strike the canoe. A number of rocks in the sea are shown by the natives, which like the Cyclopean Islands at the foot of Mount Etna, are said to have been those thrown by Pélé to sink the boat.

“This legend is very characteristic of the manners and feelings of savage life. The king is represented as taking little pains to secure the escape of anyone but himself, for his mother, wife and children are all abandoned without compunction; his conduct to the friend who accompanies him is the only trait which redeems his character from the charge of utter selfishness, nor among the natives who tell the story, is their praise of the adroitness with which he effected his escape, at all less commended on account of this desertion of his nearest relations.”

The globe is girdled by a chain of volcanic mountains in a state of greater or less activity, which may, perhaps, be considered a girdle of safety for the whole world, through which the masses of molten matter in a state of high pressure beneath the crust find a way of escape ; and thus the structure of the globe is preserved from even greater convulsions than those which from time to time take place at various points on its surface.

This girdle is partly terrestrial, partly submarine ; and commencing at Mount Erebus, near the Antarctic Pole, ranging through South Shetland Isle, Cape Horn, the Andes of South America, the Isthmus of Panama, then through Central America and Mexico, and the Rocky Mountains to Kamtschatka, the Aleutian Islands, the Kuriles, the Japanese, the Philippines, New Guinea, and New Zealand, reaches the Antarctic Circle by the Balleny Islands. This girdle sends off branches at several points.

DORMANT VOLCANIC EVENTS.

The linear arrangement of active or dormant volcanic vents has been pointed out by Humboldt, Von Buch, Daubeny and other writers. The great range of burning mountains of the Andes of Chili, Peru, Bolivia, and Mexico, that of the Aleutian Islands of Kamtschatka and the Kurile Islands, extending southwards into the Philippines, and the branching range of the Sunda Islands are well known examples. That of the West Indian Islands, ranging from Grenada through St. Vincent, St. Lucia, Martinique, Dominica, Gaudeloupe, Montserrat, Nevis, and St. Eustace, is also a remarkable example of the linear arrangement of volcanic mountains. On tracing these ranges on a map of the world it will be observed that they are either strings of islands, or lie in proximity to the ocean ; and hence the view was naturally entertained by some writers that oceanic water, or at any rate that of a large lake or sea, was a necessary agent in the production of volcanic eruptions.

This view seems to receive further corroboration from the fact that the interior portions of the continents and large islands such as Australia are destitute of volcanoes in action, with the

remarkable exceptions of Mounts Kenia and Kilimanjaro in Central Africa, and a few others. It is also very significant in this connection that many of the volcanoes now extinct, or at least dormant, both in Europe and Asia, appear to have been in proximity to sheets of water during the period of activity.

Thus the old volcanoes of the Hauran, east of the Jordan, appear to have been active at the period when the present Jordan valley was filled with water to such an extent as to constitute a lake two hundred miles in length, but which has now shrunk back to within the present limits of the Dead Sea. Again, at the period when the extinct volcanoes of Central France were in active operation, an extensive lake overspread the tract lying to the east of the granitic plateau on which the craters and domes are planted, now constituting the rich and fertile plain of Clermont.

WATER AND EXPLOSIONS.

Such instances are too significant to allow us to doubt that water in some form is very generally connected with volcanic operations; but it does not follow that it was necessary to the original formation of volcanic vents, whether linear or sporadic. If this were so, the extinct volcanoes of the British Isles would still be active, as they are close to the sea-margin, and no volcano would now be active which is not near to some large sheet of water.

But Jorullo, one of the great active volcanoes of Mexico, lies no less than 120 miles from the ocean, and Cotopaxi, in Ecuador, is nearly equally distant. Kilimanjaro, 18,881 feet high, and Kenia, in the equatorial regions of Central Africa, are about 150 miles from the Victoria Nyanza, and a still greater distance from the ocean; and Mount Demavend, in Persia, which rises to an elevation of 18,464 feet near the southern shore of the Caspian Sea, a volcanic mountain of the first magnitude, is now extinct or dormant.

Such facts as these all tend to show that although water may be an accessory of volcanic eruptions, it is not in all cases essential; and we are obliged, therefore, to have recourse to some

other theory of volcanic action differing from that which would attribute it to the access of water to highly heated or molten matter within the crust of the earth.

The view of Leopold von Buch, who considered that the great lines of volcanic mountains above referred to rise along the borders of rents, or fissures, in the earth's crust, is one which is inherently probable, and is in keeping with observation. That the crust of the globe is to a remarkable extent fissured and torn in all directions is a phenomenon familiar to all field geologists. Such rents and fissures are often accompanied by displacement of the strata, owing to which the crust has been vertically elevated on one side or lowered on the other, and such displacements (or "faults") sometimes amount to thousands of feet.

A SYSTEM OF FISSURES.

It is only occasionally, however, that such fractures are accompanied by the extrusion of molten matter; and in the north of England and Scotland dykes of igneous rock, such as basalt, which run across the country for many miles in nearly straight lines, often cut across the faults, and are only rarely coincident with them. Nevertheless, it can scarcely be a question that the grand chain of volcanic mountains which stretches almost continuously along the Andes of South America, and northwards through Mexico, has been piled up along the line of a system of fissures in the fundamental rocks parallel to the coast, though not actually coincident therewith.

The structure and arrangement of the Cordilleras of Quito, for example, are eminently suggestive of arrangement along lines of fissure. As shown by Alexander von Humboldt, the volcanic mountains are disposed in two parallel chains, which run side by side for a distance of over 500 miles northwards into the State of Columbia, and enclose between them the high plains of Quito and Lacunga. Along the eastern chain are the great cones of El Altar, rising to an elevation of 16,383 feet above the ocean, and having an enormous crater apparently dormant or extinct, and covered with snow; then Cotopaxi, its sides covered with

snow, and sending forth from its crater several columns of smoke: then Guamani and Cayambe (19,000 feet), huge truncated cones apparently extinct; these constitute the eastern chain of volcanic heights.

The western chain contains even loftier mountains. Here we find the gigantic Chimborazo, an extinct volcano whose summit is white with snow; Carihuairazo and Illiniza, a lofty pointed peak like the Matterhorn; Corazon, a snow-clad dome, reaching a height of 15,871 feet; Atacazo and Pichincha, the latter an extinct volcano reaching an elevation of 15,920 feet; such is the western chain, remarkable for its straightness, the volcanic cones being planted in one grand procession from south to north. This rectilinear arrangement of the western chain, only a little less conspicuous in the eastern, is very suggestive of a line of fracture in the crust beneath.

And when we contemplate the prodigious quantity of matter included within the limits of these colossal domes and their environments, all of which has been extruded from the internal reservoirs, we gain some idea of the manner in which the contracting crust disposes of the matter it can no longer contain.

QUITO AND PERU.

Between the volcanoes of Quito and those of Peru there is an intervening space of fourteen degrees of latitude. This is occupied by the Andes, regarding the structure of which we have not much information except that at this part of its course it is not volcanic. But from Arequipa in Peru, an active volcano, we find a new series of volcanic mountains continued southwards through Tacora (19,740 feet), then further south the more or less active vents of Sajama (22,915 feet), Coquina, Tutupaca, Calama, Atacama, Toconado, and others, forming an almost continuous range with that part of the desert of Atacama pertaining to Chili.

Through this country we find the volcanic range appearing at intervals; and still more to the southwards it is doubtless connected with the volcanoes of Patagonia, north of the Magellan Straits, and of Terra del Fuego. Mr. David Forbes considers

that this great range of volcanic mountains, lying nearly north and south, corresponds to a line of fracture lying somewhat to the east of the range.

A similar statement in all probability applies to the systems of volcanic mountains of the Aleutian Isles, Kamtschatka, the Kuriles, the Philippines, and Sunda Isles. Nor can it be reasonably doubted that the Western American coast line has to a great extent been determined, or marked out, by such lines of displacement; for, as Darwin has shown, the whole western coast of South America, for a distance of between 2000 and 3000 miles south of the Equator, has undergone an upward movement in very recent times—that is, within the period of living marine shells—during which period the volcanoes have been in activity.

GROUPS OF VOLCANOES.

This chain may also be cited in evidence of volcanic action along fissure lines. It connects the volcanoes of Kamtschatka with those of Japan, and the linear arrangement is apparent. In the former peninsula Erman counted no fewer than thirteen active volcanic mountains rising to heights of 12,000 to 15,000 feet above the sea. In the chain of the Kuriles Professor John Milne counted fifty-two well-defined volcanoes, of which nine, perhaps more, are certainly active.

They are not so high as those of Kamtschatka; but, on the other hand, they rise from very deep oceanic waters, and have been probably built up from the sea bottom by successive eruptions of tuff, lava, and ash. According to the view of Professor Milne, the volcanoes of the Kurile chain are fast becoming extinct.

Besides the volcanic vents arranged in lines, of which we have treated above, there are a large number, both active and extinct, which appear to be disposed in groups, or sporadically distributed, over various portions of the earth's surface. I say appear to be, because this sporadic distribution may really be resolvable (at least in some cases) into linear distribution for short distances. Thus the Neapolitan Group, which might at first sight seem to

be arranged around Vesuvius as a centre, really resolves itself into a line of active and extinct vents of eruption, ranging across Italy from the Tyrrhenian Sea to the Adriatic, through Ischia, Procida, Monte Nuovo and the Phlegræan Fields, Vesuvius and Mount Vulture.

Again, the extinct volcanoes of Central France, which appear to form an isolated group, indicate, when viewed in detail, a linear arrangement ranging from north to south. Another region over which extinct craters are distributed lies along the banks of the Rhine, above Bonn and the Moselle; a fourth in Hungary; a fifth in Asia Minor and Northern Palestine; and a sixth in Central Asia around Lake Balkash. These are all continental, and the linear distribution is not apparent.

By far the most extensive regions with sporadically distributed volcanic vents, both active and extinct, are those which are overspread by the waters of the ocean, where the vents emerge in the form of islands. These are to be found in all the great oceans, the Atlantic, the Pacific, and the Indian; but are especially numerous over the central Pacific region.

VOLCANIC CORAL REEFS.

As Kotzebue and subsequently Darwin have pointed out, all the islands of the Pacific are either coral-reefs or of volcanic origin; and many of these rise from great depths; that is to say, from depths of 1000 to 2000 fathoms. It is unnecessary here to attempt to enumerate all these islands which rise in solitary grandeur from the surface of the ocean, and are the scenes of volcanic operations; a few may, however, be enumerated.

In the Atlantic, Iceland first claims notice, owing to the magnitude and number of its active vents and the variety of the accompanying phenomena, especially the geysers. As Lyell has observed, with the exception of Etna and Vesuvius, the most complete chronological records of a series of eruptions in existence are those of Iceland, which come down from the ninth century of our era, and which go to show that since the twelfth century there has never been an interval of more than forty years without either

an eruption or a great earthquake. So intense is the volcanic energy in this island that some of the eruptions of Hecla have lasted six years without cessation.

Earthquakes have often shaken the whole island at once, causing great changes in the interior, such as the sinking down of hills, the rending of mountains, and the desertion by rivers of their channels, and the appearance of new lakes. New islands have often been thrown up near the coast, while others have disappeared. In the intervals between eruptions, innumerable hot springs afford vent to the subterranean heat, and solfataras discharge copious streams of inflammable matter. The volcanoes in different parts of the island are observed, like those of the Phlegrean Fields, to be in activity by turns, one vent serving for a time as a safety-valve for the others.

A HISTORIC ERUPTION.

The most memorable eruption of recent years was that of Skapta Jokul in 1783, when a new island was thrown up, and two torrents of lava issued forth, one forty-five and the other fifty miles in length, and which, according to the estimate of Professor Bischoff, contained matter surpassing in magnitude the bulk of Mont Blanc. One of these streams filled up a large lake, and entering the channel of the Skapta, completely dried up the river. The volcanoes of Iceland may be considered as safety-valves to the region in which lie the British Isles.

This group of volcanic isles rises from deep Atlantic waters north of the Equator, and the vents of eruption are partially active, partially dormant, or extinct. It must be supposed, however, that at a former period volcanic action was vastly more energetic than at present; for except at the Grand Canary, Gomera, Forta Ventura and Lancerote, where various non-volcanic rocks are found, these islands appear to have been built up from their foundations of eruptive materials.

The highest point in the Azores is the Peak of Pico, which rises to a height of 7016 feet above the ocean. But this great elevation is surpassed by that of the Peak of Teneriffe (or Pic de

Teyde) in the Canaries, which attains to an elevation of 12,225 feet, as determined by Professor Piazzzi Smyth.

This great volcanic cone, rising from the ocean, its summit shrouded in snow, and often protruding above the clouds, must be an object of uncommon beauty and interest when seen from the deck of a ship. The central cone, formed of trachyte, pumice, obsidian and ashes, rises out of a vast cauldron of older basaltic rocks with precipitous inner walls—much as the cone of Vesuvius rises from within the partially encircling walls of Somma. From the summit issue forth sulphurous vapors, but no flame.

OUTER RING OF BASALT.

Piazzzi Smyth, who during a prolonged visit to this mountain in 1856 made a careful survey of its form and structure, shows that the great cone is surrounded by an outer ring of basalt enclosing two foci of eruption, the lavas from which have broken through the ring of the outer crater on the western side, and have poured down the mountain. At the top of the peak its once active crater is filled up, and we find a convex surface ("The Plain of Rambleta") surmounted towards its eastern end by a diminutive cone, 500 feet high, called "Humboldt's Ash Cone." The slope of the great cone of Teneriffe ranges from 28° to 38° ; and below a level of 7000 feet the general slope of the whole mountain down to the water's edge varies from 10° to 12° from the horizontal. The great cone is penetrated by numerous basaltic dykes.

The Cape de Verde Islands, which contain beds of limestone along with volcanic matter, possess in the island of Fuego an active volcano, rising to a height of 7000 feet above the surface of the ocean. The central cone, like that of Teneriffe, rises from within an outer crater, formed of basalt alternating with beds of agglomerate, and traversed by numerous dykes of lava. This has been broken down on one side like that of Somma; and over its flanks are scattered numerous cones of scoria, the most recent dating from the years 1785 and 1799.

CHAPTER XVII

AMAZING PHENOMENA CONNECTED WITH VOLCANOES AND EARTHQUAKES.—FIERY EXPLOSIONS AND MOUNTAINS IN CONVULSIONS.—CHANGES IN THE SURFACE OF THE EARTH.

BY SIR. JOHN F. W. HERSCHEL, BART.

[The following accurate and scientific account of the causes and effects of volcanoes and earthquakes is furnished by the most eminent authority on these subjects known to the world, and is of special interest in connection with the great disasters

I PURPOSE to say something about volcanoes and earthquakes. It is a subject I have thought a good deal about, and though I have never been so fortunate as to have been shaken out of my bed by an earthquake, still I have climbed the cones of Vesuvius and Etna, hammer in hand and barometer on back, and have wandered over and geologized among, I believe, nearly all the principal scenes of extinct volcanic activity in Europe.

Every one knows that a volcano is a mountain that vomits out fire, and smoke, and cinders, and melted lava, and sulphur, and steam, and gases, and all kinds of horrible things; nay, even sometimes mud, and boiling water, and fishes; and everybody has heard or read of the earth opening, and swallowing up man and beast, and houses and churches; and closing on them with a snap, and smashing them to pieces; and then perhaps opening again, and casting them out with a flood of dirty water from some river or lake that has been gulped down with them. Now, all this, and much more, is literally true, and has happened over and over again; and when we have imagined it all, we shall have formed a tolerably correct notion of some at least of these visitations.

And perhaps some may have been tempted to ask why and how it is that God has permitted this fair earth to be visited with such destruction. It can hardly be for the sins of men : for when these things occur they involve alike the innocent and the guilty ; and besides, the volcano and the earthquake were raging on this earth with as much, nay greater violence, thousands and thousands of years before man set foot upon it. But perhaps, on the other hand, it may have occurred to some to ask themselves whether it is not just possible that these ugly affairs are sent among us for some beneficent purposes ; or at all events that they may form part and parcel of some great scheme of providential arrangement which is at work for good and not for ill.

INCIDENTAL CATASTROPHES.

A ship sometimes strikes on a rock, and all on board perish ; a railway train runs into another, or breaks down, and then wounds and contusions are the order of the day ; but nobody doubts that navigation and railway communication are great blessings. None of the great natural provisions for producing good are exempt in their workings from producing occasional mischief. Storms disperse and dilute pestilential vapors, and lightnings decompose and destroy them ; but both the one and the other often annihilate the works of man, and inflict upon him sudden death.

Well, then, I think I shall be able to show that the volcano and the earthquake, dreadful as they are, as local and temporary visitations, are in fact unavoidable (I had almost said necessary) incidents in a vast system of action to which we owe the very ground we stand upon, the very land we inhabit, without which neither man, beast, nor bird would have a place for their existence, and the world would be the habitation of nothing but fishes.

Now, to make this clear, I must go a little out of my way and say something about the first principles of geology. Geology does not pretend to go back to the creation of the world, or concern itself about its primitive state, but it does concern itself with the changes it sees going on in it now, and with the evidence of a long series of such changes it can produce in the most unmistakable

features of the structure of our rocks and soil, and the way in which they lie one on the other.

As to what we see going on.—We see everywhere, and along every coast-line, the sea warring against the land, and everywhere overcoming it; wearing and eating it down, and battering it to pieces; grinding those pieces to powder; carrying the powder away, and spreading it out over its own bottom, by the continued effect of the tides and currents. Look at our chalk cliffs, which once, no doubt, extended across the Channel to the similar cliffs on the French coast.

What do we see? Precipices cut down to the sea-beach, constantly hammered by the waves and constantly crumbling: the beach itself made of the flints outstanding after the softer chalk had been ground down and washed away; themselves grinding one another under the same ceaseless discipline; first rounded into pebbles, then worn into sand, and then carried out farther and farther down the slope, to be replaced by fresh ones from the same source.

PROCESSES GOING ON.

Well, the same thing is going on everywhere, round every coast of Europe, Asia, Africa and America. Foot by foot or inch by inch, month by month or century by century, down everything must go. Time is as nothing in geology. And what the sea is doing the river is helping it to do. Look at the sand-banks at the mouth of the Thames. What are they but the materials of our island carried out to sea by the stream? The Ganges carries away from the soil of India, and delivers into the sea, twice as much solid substance weekly as is contained in the great pyramid of Egypt. The Irawaddy sweeps off from Burmah sixty-two cubic feet of earth in every second of time on an average, and there are 86,400 seconds in every day, and 365 days in every year; and so on for the other rivers.

What has become of all that great bed of chalk which once covered all the weald of Kent, and formed a continuous mass from Ramsgate and Dover to Beechy Head, running inland to Madams-

court Hill and Seven Oaks? All clean gone, and swept out into the bosom of the Atlantic, and there forming other chalk-beds. Now, geology assures us, on the most conclusive and undeniable evidence, that all our present land, all our continents and islands have been formed in this way out of the ruins of former ones. The old ones which existed at the beginning of things have all perished, and what we now stand upon has most assuredly been, at one time or other, perhaps many times, the bottom of the sea.

Well, then, there is power enough at work, and it has been at work long enough utterly to have cleared away and spread over the bed of the sea all our present existing continents and islands, had they been placed where they are at the creation of the world; and from this it follows as clear as demonstration can make it, that without some process of renovation and restoration to act in antagonism to this destructive work of old Neptune, there would not now be remaining a foot of dry land for living thing to stand upon.

WERE HOISTED AT ONE BLOW.

Now, what is this process of restoration? Let the volcano and the earthquake tell their tale. Let the earthquake tell how, within the memory of man—under the eyesight of eye-witnesses, one of whom (Mrs. Graham) has described the fact—the whole coast line of Chili, for one hundred miles about Valparaiso, with the mighty chain of the Andes—mountains to which the Alps sink into insignificance—was hoisted at one blow (in a single night, Nov. 19, A. D. 1822) from two to seven feet above its former level, leaving the beach below the old water mark high and dry; leaving the shell-fish sticking on the rocks out of reach of water; leaving the seaweed rotting in the air, or rather drying up to dust under the burning sun of a coast where rain never falls.

The ancients had a fable of Titan hurled from heaven and buried under Etna, and by his struggles causing the earthquakes that desolated Sicily. But here we have an exhibition of Titanic forces on a far mightier scale. One of the Andes upheaved on this occasion was the gigantic mass of Aconagva, which overlooks Valparaiso. To bring home to the mind the conception of such

an effort, we must form a clear idea of what sort of mountain this is. It is nearly 24,000 feet in height.

Chimborazo, the loftiest of the volcanic cones of the Andes, is lower by 2,500 feet; and yet Etna, with Vesuvius at the top of it, and another Vesuvius piled on that, would little more than surpass the midway portion of the snow-covered portion of that cone, which is one of the many chimneys by which the hidden fires of the Andes find vent. On the occasion I am speaking of, at least ten thousand square miles of country were estimated as having been upheaved, and the upheaval was not confined to the land, but extended far away to sea, which was proved by the soundings off Valparaiso and along the coast, having been found considerably shallower than they were before the shock.

Again, in the year 1819, in an earthquake in India, in the district of Cutch, bordering on the Indus, a tract of country more than fifty miles long and sixteen broad was suddenly raised ten feet above its former level. The raised portion still stands up above the unraised like a long perpendicular wall, which is known by the name of the "Ullah Bund," or "God's Wall."

GIGANTIC UPHEAVALS.

And again, in 1538, in that convulsion which threw up the Monte Nuovo (New Mountain), a cone of ashes 450 feet high, in a single night; the whole coast of Pozzuoli, near Naples, was raised twenty feet above its former level, and remains so permanently upheaved to this day. And I could mention innumerable other instances of the same kind.

This, then, is the manner in which the earthquake does its work; and it is always at work. Somewhere or other in the world, there is perhaps not a day, certainly not a month, without an earthquake. In those districts of South and Central America, where the great chain of volcanic cones is situated—Chimborazo, Cotopaxi, and a long list with names unmentionable, or at least unpronounceable—the inhabitants no more think of counting earthquake shocks than we do of counting showers of rain.

Indeed, in some places along the coast, a shower is a greater,

rarity. Even in our own island, near Perth, a year seldom passes without a shock, happily, within the records of history, never powerful enough to do any mischief.

It is not everywhere that this process goes on by fits and starts. For instance, the northern gulfs, and borders of the Baltic Sea, are steadily shallowing; and the whole mass of Scandinavia including Norway, Sweden and Lapland, is rising out of the sea at the average rate of about two feet per century. But as this fact (which is perfectly well established by reference to ancient high and low water marks) is not so evidently connected with the action of earthquakes, I shall not refer to it just now.

All that I want to show is, that there is a great cycle of changes going on, in which the earthquake and volcano act a very conspicuous part, and that part a restorative and conservative one; in opposition to the steadily destructive and leveling action of the ocean waters.

CAUSES OF THE PHENOMENA.

How this can happen; what can be the origin of such an enormous power thus occasionally exerting itself, will no doubt seem very marvelous—little short, indeed, of miraculous intervention—but the mystery, after all, is not quite so great as at first seems. We are permitted to look a little way into these great secrets; not far enough, indeed, to clear up every difficulty, but quite enough to penetrate us with admiration of that wonderful system of counterbalances and compensations; that adjustment of causes and consequences, by which, throughout all nature, evils are made to work their own cure; life to spring out of death; and renovation to tread in the steps and efface the vestiges of decay.

The key to the whole affair is to be found in the central heat of the earth. This is no scientific dream, no theoretical notion, but a fact established by direct evidence up to a certain point, and standing out from plain facts as a matter of unavoidable conclusion, in a hundred ways.

We all know that when we go into a cellar out of a summer

sun it feels cool ; but when we go into it out of a wintry frost it is warm. The fact is, that a cellar, or a well, or any pit of a moderate depth, has always, day and night, summer and winter, the same degree of warmth, the same temperature, as it is called ; and that always and everywhere is the same, or nearly the same, as the average warmth of the climate of the place. Forty or fifty feet deep in the ground, the thermometer here in this spot, would always mark the same degree, 49° , that is, or seventeen degrees above the freezing point. Under the equator, at the same depth, it always stands at 84° , which is our hot summer heat, but which there is the average heat of the whole year.

And this is so everywhere. Just at the surface, or a few inches below it, the ground is warm in the daytime, cool at night ; at two or three feet deep the difference of day and night is hardly perceptible, but that of summer and winter is considerable. But at forty or fifty feet this difference also disappears, and you find a perfectly fixed, uniform degree of warmth, day and night ; summer and winter ; year after year.

HOTTER AS WE GO DOWN.

But when we go deeper, as, for instance, down into mines or coal-pits, this one broad and general fact is always observed—everywhere, in all countries, in all latitudes, in all climates, wherever there are mines, or deep subterranean caves—the deeper you go, the hotter the earth is found to be. In one and the same mine, each particular depth has its own particular degree of heat, which never varies : but the lower always the hotter ; and that not by a trifling, but what may well be called an astonishingly rapid rate of increase—about a degree of the thermometer additional warmth for every 90 feet of additional depth, which is about 58° per mile !—so that, if we had a shaft sunk a mile deep, we should find in the rock a heat of 105° , which is much hotter than the hottest summer day ever experienced

It is not everywhere, however, that it is worth while to sink a shaft to any great depth ; but borings for water (in what are called Artesian wells) are often made to enormous depths, and the

water always comes up hot ; and the deeper the boring, the hotter the water. There is a very famous boring of this sort in Paris, at La Grenelle. The water rises from a depth of 1794 feet, and its temperature is 82° of our scale, which is almost that of the equator. And, again, at Salzwerth, in Oeynhausen, in Germany, in a boring for salt springs 2144 feet deep, the salt water comes up with with a still higher heat, viz., 91° .

Then, again, we have natural hot water springs, which rise, it is true, from depths we have no means of ascertaining ; but which, from the earliest recorded times, have always maintained the same heat. At Bath, for instance, the hottest well is 117° Fahr. On the Arkansas River, in the United States, is a spring of 180° , which is scalding hot ; and that out of the neighborhood of any volcano.

MASS OF RED-HOT IRON.

Now, only consider what sort of a conclusion this lands us in. This globe of ours is 8000 miles in diameter ; a mile deep on its surface is a mere scratch. If a man had twenty greatcoats on, and I found under the first a warmth of 60° above the external air, I should expect to find 60° more under the second, and 60° more under the third, and so on ; and, within all, no man, but a mass of red-hot iron.

Just so with the outside crust of the earth. Every mile thick is such a greatcoat, and at twenty miles depth, according to this rate, the ground must be fully red-hot ; and at no such very great depth beyond, either the whole must be melted, or only the most infusible and intractable kinds of material, such as our fireclays and flints, would present some degree of solidity.

In short, what the icefloes and icebergs are to the polar seas, so we shall come to regard our continents and mountain-ranges in relation to the ocean of melted matter beneath. I do not mean to say there is no solid central mass ; there may be one, or there may not, and, upon the whole, I think it likely enough that there is—kept solid, in spite of the heat, by the enormous pressure, but that has nothing to do with the present argument.

All that I contend for is this.—Grant me a sea of liquid fire, on which we are all floating—land and sea ; for the bottom of the sea anyhow will not come nearly down to the lava level. The sea is probably nowhere more than five or six miles deep, which is far enough above that level to keep its bed from becoming red-hot.

Well, now, the land is perpetually wearing down, and the materials being carried out to sea. The coat of heavier matter is thinning off towards the land, and thickening over all the bed of the sea. What must happen ? If a ship float even on her keel, transfer weight from the starboard to her larboard side, will she continue to float even ? No, certainly. She will heel over to larboard. Many a good ship has gone to the bottom in this way. If the continents be lightened, they will rise ; if the bed of the sea receive additional weight, it will sink.

BOTTOM OF THE OCEAN SINKING.

The bottom of the Pacific is sinking, in point of fact. Not that the Pacific is becoming deeper. This seems a paradox ; but it is easily explained. The whole bed of the sea is in the act of being pressed down by the laying on of new solid substance over its bottom. The new bottom then is laid upon the old, and so the actual bed of the ocean remains at or nearly at the same distance from the surface water. But what becomes of the islands ? They form part and parcel of the old bottom ; and Dr. Darwin has shown, by the most curious and convincing proofs, that they are sinking, and have been sinking for ages, and are only kept above water—by what, think you ? By the labors of the coral insects, which always build up to the surface !

It is impossible but that this increase of pressure in some places and relief in others must be very unequal in their bearings. So that at some place or other this solid floating crust must be brought into a state of strain, and if there be a weak or soft part, a crack will at last take place. When this happens, down goes the land on the heavy side and up on the light side. Now this is exactly what took place in the earthquake which raised the Ullah Bund in Cutch.

I have told you of a great crack drawn across the country, not far from the coast line ; the inland country rose ten feet, but much of the sea-coast, and probably a large tract in the bed of the Indian Ocean, sank considerably below its former level. And just as you see when a crack takes place in ice, the water oozes up ; so this kind of thing is always, or almost always, followed by an upburst of the subterranean fiery matter. The earthquake of Cutch was terminated by the outbreak of a volcano at the town of Bhooi, which it destroyed.

Now where, following out this idea, should we naturally expect such cracks and outbreaks to happen? Why, of course, along those lines where the relief of pressure on the land side is the greatest, and also its increase on the sea side ; that is to say, along or in the neighborhood of the sea-coasts, where the destruction of the land is going on with most activity.

CLOSE TO THE COAST LINE.

Well, now, it is a remarkable fact in the history of volcanoes, that there is hardly an instance of an active volcano at any considerable distance from the sea coast. All the great volcanic chain of the Andes is close to the western coast line of America. Etna is close to the sea ; so is Vesuvius ; Teneriffe is very near the African coast ; Mount Erebus is on the edge of the great Antarctic continent.

Out of 225 volcanoes which are known to be in actual eruption over the whole earth within the last 150 years, I remember only a single instance of one more than 320 miles from the sea, and that is on the edge of the Caspian, the largest of the inland seas—I mean Mount Demawend in Persia.

Suppose from this, or any other cause, a crack to take place in the crust of the earth. Don't imagine that the melted matter below will simply ooze up quietly, as water does from under an ice-crack. No such thing. There is an element in the case we have not considered ; steam and condensed gases. We all know what takes place in a high pressure steam-boiler, with what violence the contents escape, and what havoc takes place.

Now there is no doubt that among the minerals of the subterranean world, there is water in abundance, and sulphur, and many other vaporizable substances, all kept subdued and repressed by the enormous pressure. Let this pressure be relieved, and forth they rush, and the nearer they approach the surface the more they expand, and the greater is the explosive force they acquire; till at length, after more or fewer preparatory shocks, each accompanied with progressive weakening of the overlying strata, the surface finally breaks up, and forth rushes the imprisoned power, with all the awful violence or a volcanic eruption.

Certainly a volcano does seem to be a very bad neighbor; and yet it affords a compensation in the extraordinary richness of the volcanic soil, and the fertilizing quality of the ashes thrown out. The flanks of Somma (the exterior crater of Vesuvius) are covered with vineyards producing wonderful wine, and whoever has visited Naples, will not fail to be astonished at the productiveness of volcanized territory as contrasted with the barrenness of the limestone rocks bordering on it.

THREE CROPS AT ONCE.

There you will see the amazing sight (as an English farmer would call it) of a triple crop growing at once on the same soil; a vineyard, an orchard, and a cornfield all in one. A magnificent wheat crop, five or six feet high, overhung with clustering grapevines swinging from one apple or pear tree to another in the most luxuriant festoons! When I visited Somma, to see the country where the celebrated wine, the *Lacryma Christi*, is grown, it was the festival of Madonna del Arco. Her church was crowded to suffocation with a hot and dusty assemblage of the peasantry. The fine impalpable volcanic dust was everywhere; in your eyes, in your mouth, begriming every pore; and there I saw what I shall never forget. Jammed among the crowd, I felt something jostling my legs.

Looking down, and the crowd making way, I beheld a line of worshipers crawling on their hands and knees from the door of the church to the altar, licking the dusty pavement all the way

with their tongues, positively applied to the ground and no mistake. No trifling dose of *Lacryma* would be required to wash down what they must have swallowed on that journey, and I have no doubt it was administered pretty copiously after the penance was over.

Now I come to consider the manner in which an earthquake is propagated from place to place; how it travels, in short. It runs along the earth precisely in the same manner, and according to the same mechanical laws as a wave along the sea, or rather as the waves of sound run along the air, but quicker.

The earthquake which destroyed Lisbon ran out from thence, as from a centre, in all directions, at a rate averaging about twenty miles per minute, as far as could be gathered from a comparison of the time of its occurrence at different places; but there is little doubt that it must have been retarded by having to traverse all sorts of ground, for a blow or shock of any description is conveyed through the substance on which it is delivered with the rapidity of sound in that substance.

SOUND CONVEYED BY WATER.

Perhaps it may be new to many to be told that sound is conveyed by water, by stone, by iron, and indeed, by everything, and at a different rate for each. In air it travels at the rate of about 1140 feet per second, or about thirteen miles a minute. In water much faster, more than four times as fast (4700 feet). In iron ten times as fast (11,400 feet), or about 130 miles in a minute, so that a blow delivered endways at one end of an iron rod, 130 miles long, would only reach the other after a lapse of a minute, and a pull at one end of an iron wire of that length, would require a minute before it would be felt at the other.

But the substance of the earth through which the shock is conveyed is not only far less elastic than iron, but it does not form a coherent, connected body; it is full of interruptions, cracks, loose materials, and all of these tend to deaden and retard the shock; and putting together all the accounts of all the earthquakes that have been exactly observed, their rate of travel may

be taken to vary from as low as twelve or thirteen miles a minute to seventy or eighty; but perhaps the low velocities arise from oblique waves.

The way, then, that we may conceive an earthquake to travel is this—I shall take the case which is most common, when the motion of the ground to-and-fro is horizontal. How far each particular spot on the surface of the ground is actually pushed from its place there is no way of ascertaining, since all the surrounding objects receive the same impulse almost at the same instant of time, but there are many indications that it is often several yards.

GROUND SMITTEN BY TREES.

In the earthquake of Cutch, which I have mentioned, trees were seen to flog the ground with their branches, which proves that their stems must have been jerked suddenly away for some considerable distance and as suddenly pushed back; and the same conclusion follows from the sudden rise of the water of lakes on the side where the shock reaches them, and its fall on the opposite side; the bed of the lake has been jerked away for a certain distance from under the water and pulled back.

Now, suppose a row of sixty persons, standing a mile apart from each other, in a straight line, in the direction in which the shock travels; at a rate, we will suppose, of sixty miles per minute; and let the ground below the first get a sudden and violent shove, carrying it a yard in the direction of the next. Since this shock will not reach the next till after the lapse of one second of time, it is clear that the space between the two will be shortened by a yard, and the ground—that is to say, not the mere loose soil on the surface, but the whole mass of solid rock below, down to an unknown depth—compressed, or driven into a smaller space.

It is this compression that carries the shock forwards. The elastic force of the rocky matter, like a coiled spring acts both ways; it drives back the first man to his old place, and shoves the second a yard nearer the third, and so on. Instead of men place a row of tall buildings, or columns, and they will tumble down in

succession, the base flying forwards, and leaving the top behind to drop on the soil on the side from which the shock came.

This is just what has happened in Messina in the great Catlabrian earthquake. As the shock ran along the ground, the houses of the Faro were seen to topple down in succession; beginning at one end and running on to the other, as if a succession of mines had been sprung. In the earthquake in Cutch, a sentinel standing at one end of a long straight line of wall, saw the wall bow forward and recover itself; not all at once, but with a swell like a wave running all along it with immense rapidity.

In this case it is evident that the earthquake wave must have its front oblique to the direction of the wall (just as an obliquely-held rule runs along the edge of a page of paper while it advances, like a wave of the sea, perpendicularly to its own length).

CONCERNING EXTINCT VOLCANOES.

In reference to extinct volcanoes, I may just mention that any one who wishes to see some of the finest specimens in Europe may do so by making a couple of days' railway travel to Clermont, in the department of the Puy-de-Dome in France. There he will find a magnificent series of volcanic cones, fields of ashes, streams of lavas, and basaltic terraces of platforms, proving the volcanic action to have been continued for countless ages before the present surface of the earth was formed; and all so clear that he who runs may read their lesson. There can there be seen a configuration of surface quite resembling what telescopes show in the most volcanic districts of the moon. Let not my hearers be startled; half the moon's face is covered with unmistakable craters of extinct volcanoes.

Many of the lavas of Auvergne and the Puy-de-Dome are basaltic; that is, consisting of columns placed close together; and some of the cones are quite complete, and covered with loose ashes and cinders, just as Vesuvius is at this hour.

In the study of these vast and awful phenomena we are brought in contact with those immense and rude powers of nature which seem to convey to the imagination the impress of brute

force and lawless violence ; but it is not so. Such an idea is not more derogatory to the wisdom and benevolence that prevails throughout all the scheme of creation than it is in itself erroneous. In their wildest paroxysms the rage of the volcano and the earthquake is subject to great and immutable laws : they feel the bridle and obey it.

The volcano bellows forth its pent-up overplus of energy and sinks into long and tranquil repose. The earthquake rolls away, and industry, that balm which nature knows how to shed over every wound, effaces its traces, and festoons its ruins with flowers. There is mighty and rough work to be accomplished, and it cannot be done by gentle means. It seems, no doubt, terrible, awful, perhaps harsh, that twenty or thirty thousand lives should be swept away in a moment by a sudden and unforeseen calamity ; but we must remember that sooner or later every one of those lives must be called for, and it is by no means the most sudden end that is the most afflictive.

NATURE'S TREMENDOUS ENERGIES.

It is well too that we should contemplate occasionally, if it were only to teach us humility and submission, the immense energies which are everywhere at work in maintaining the system of nature we see going on so smoothly and tranquilly around us, and of which these furious outbreaks, after all, are but minute, and for the moment unbalanced surpluses in the great account. The energy requisite to overthrow a mountain is as a drop in the ocean compared with that which holds it in its place, and makes it a mountain. Chemistry tells us that the forces constantly in action to maintain a single grain of water in its habitual state, when only partially and sparingly let loose in the form of electricity, would manifest themselves as a powerful flash of lightning.

And we learn from optical science that in even the smallest element of every material body, nay, even in what we call empty space, there are forces in perpetual action to which even such energies sink into insignificance. Yet, amid all this, nature holds her even course : the flowers blossom ; animals enjoy their

brief span of existence ; and man has leisure and opportunity to contemplate and adore, secure of the watchful care which provides for his well-being at every instant that he is permitted to remain on earth.

The first great earthquake of which any very distinct knowledge has reached us is that which occurred in the year 63 after our Saviour, which produced great destruction in the neighborhood of Vesuvius, and shattered the cities of Pompeii and Herculaneum upon the Bay of Naples, though it did not destroy them. This earthquake is chiefly remarkable as having been the forerunner and the warning (if that warning could have been understood) of the first eruption of Vesuvius on record, which followed sixteen years afterwards in the year 79.

DID NOT KNOW IT WAS A VOLCANO.

Before that time none of the ancients had any notion of its being a volcano, though Pompeii itself is paved with its lava. The crater was probably filled, or at least the bottom occupied, by a lake ; and we read of it as the stronghold of the rebel chief Spartacus, who, when lured there by the Roman army, escaped with his followers by clambering up the steep sides by the help of the wild vines that festooned them. The ground since the first earthquake in 63 had often been shaken by slight shocks, when at length, in August 79, they became more numerous and violent, and, on the night preceding the eruption, so tremendous as to threaten everything with destruction.

A morning of comparative repose succeeded, and the terrified inhabitants of those devoted towns no doubt breathed more freely, and hoped the worst was over, when, about one o'clock in the afternoon, the Elder Pliny, who was stationed in command of the Roman fleet at Misenum in full view of Vesuvius, beheld a huge black cloud ascending from the mountain, which, "rising slowly always higher," at last spread out aloft like the head of one of those picturesque flat-topped pines which form such an ornament of the Italian landscape.

The meaning of such a phenomenon was to Pliny and to

everyone a mystery. We know now too well what it imports, and they were not long left in doubt. From that cloud descended



TERRIFIC ERUPTION OF THE GREAT CRATER OF VESUVIUS.

stones, ashes, and pumice; and the cloud itself lowered down upon the surrounding country, involving land and sea in profound darkness, pierced by flashes of fire more vivid than lightning.

These, with the volumes of ashes that began to encumber the soil, and which covered the sea with floating pumice-stone; the constant heaving of the ground; and the sudden recoil of the sea, form a picture which is wonderfully well described by the the Younger Pliny. His uncle, animated by an eager desire to know what was going on, and to afford aid to the inhabitants of the towns, made sail for the nearest point of the coast and landed; but was instantly enveloped in the dense sulphureous vapor that swept down from the mountain, and perished miserably.

It does not seem that any lava flowed on that occasion. Pompeii was buried under the ashes; Herculaneum by a torrent of mud, probably the contents of the crater, ejected at the first explosion. This was most fortunate. We owe to it the preservation of some of the most wonderful remains of antiquity. For it is not yet much more than a century ago that, in digging a well at Portici near Naples, the Theatre of Herculaneum was discovered, some sixty feet under ground,—then houses, baths, statues, and, most interesting of all, a library full of books; and those books still legible, and among them the writings of some ancient authors which had never before been met with, but which have now been read, copied, and published, while hundreds and hundreds, I am sorry to say, still remain unopened.

Pompeii was not buried so deep; the walls of some of the buildings appeared among the modern vineyards, and led to excavations which were easy, the ashes being light and loose. And there you now may walk through the streets, enter the houses and find the skeletons of their inmates, some in the very act of trying to escape. Nothing can be more strange and striking.

Since that time Vesuvius has been frequently, but very irregularly, in eruption. The next after Pompeii was in the year 202, under Severus, and in 472 occurred an eruption so tremendous that all Europe was covered by the ashes, and even Constantinople thrown into alarm. This may seem to savor of the marvelous, but before I have done I hope to show that it is not beyond what we know of the power of existing volcanoes.

CHAPTER XVIII.

GREAT VOLCANIC ERUPTIONS IN MANY PARTS OF THE WORLD.
STORY OF MT. ETNA.—CONVULSIONS IN SOUTH AMERICA
AND ELSEWHERE.

I SHALL not, of course, occupy attention with a history of Vesuvius, but pass at once to the eruption of 1779—one of the most interesting on record, from the excellent account given of it by Sir William Hamilton, who was then resident at Naples as our Minister, and watched it throughout with the eye of an artist as well as the scrutiny of a philosopher.

In 1767, there had been a considerable eruption, during which Pliny's account of the great pine-like, flat-topped, spreading mass of smoke had been superbly exemplified; extending over the Island of Capri, which is twenty-eight miles from Vesuvius. The showers of ashes, the lava currents, the lightnings, thunderings, and earthquakes were very dreadful; but they were at once brought to a close when the mob insisted that the head of St. Januarius should be brought out and shown to the mountain; and when this was done, all the uproar ceased on the instant, and Vesuvius became as quiet as a lamb!

He did not continue so, however, and it would have been well for Naples if the good Saint's head could have been permanently fixed in some conspicuous place in sight of the hill—for from that time till the year 1779 it never was quiet.

In the spring of that year it began to pour out lava; and on one occasion, when Sir William Hamilton approached too near, the running stream was on the point of surrounding him; and the sulphureous vapor cut off his retreat, so that his only mode of escape was to walk across the lava, which, to his astonishment, and, no doubt, to his great joy, he found accompanied with no difficulty, and with no more inconvenience than what proceeded from the radiation of heat on his legs and feet from the scoriæ and cinders with which the external crust of the lava was loaded;

and which in great measure intercepted and confined the glowing heat of the ignited mass below.

In such cases, and when cooled down to a certain point, the motion of the lava-stream is slow and creeping; rather rolling over itself than flowing like a river; the top becoming the bottom, owing to the toughness of the half-congealed crust. When it issues, however, from any accessible vent, it is described as perfectly liquid, of an intense white heat, and spouting or welling forth with extreme rapidity.

So Sir Humphrey Davy described it in an eruption at which he was present; and so Sir William Hamilton, in the eruption we are now concerned with, saw it "bubbling up violently" from one of its fountains on the slope of the volcano, "with a hissing and crackling noise, like that of an artificial firework; and forming, by the continual splashing up of the vitrified matter, a sort of dome or arch over the crevice from which it issued," which was all, internally, "red-hot like a heated oven."

RUMBLING NOISES AND EXPLOSIONS. -

However, as time went on, this quiet mode of getting rid of its contents would no longer suffice, and the usual symptoms of more violent action—rumbling noises and explosions within the mountain; puffs of smoke from its crater, and jets of red-hot stones and ashes—continued till the end of July, when they increased to such a degree as to exhibit at night the most beautiful firework imaginable.

The eruption came to its climax from the 5th to the 10th of August, on the former of which days, after the ejection of an enormous volume of white clouds, piled like bales of the whitest cotton, in a mass exceeding four times the height and size of the mountain itself; the lava began to overflow the rim of the crater, and stream in torrents down the steep slope of the cone. This was continued till the 8th, when the great mass of the lava would seem to have been evacuated, and no longer repressing by its weight the free discharge of the imprisoned gases, allowed what remained to be ejected in fountains of fire, carried up to an

immense height in the air. The description of one of these I must give in the picturesque and vivid words of Sir William Hamilton himself.

"About nine o'clock," he says, on Sunday the 8th of August, "there was a loud report, which shook the houses at Portici and



NAPLES, SHOWING MOUNT VESUVIUS IN THE DISTANCE.

its neighborhood to such a degree as to alarm the inhabitants and drive them out into the streets. Many windows were broken, and as I have since seen, walls cracked by the concussion of the air from that explosion. In one instant a fountain of liquid transparent fire began to rise, and gradually increasing, arrived at so amazing a height as to strike every one who beheld it with the most awful astonishment. I shall scarcely be credited when I

assure you that, to the best of my judgment, the height of this stupendous column of fire could not be less than three times that of Vesuvius itself; which, you know, rises perpendicularly near 3,700 feet above the level of the sea." (The height of my own measurement in 1824 is 3,920 feet.)

"Puffs of smoke, as black as can possibly be imagined, succeeded one another hastily, and accompanied the red-hot, transparent, and liquid lava, interrupting its splendid brightness here and there by patches of the darkest hue. Within these puffs of smoke, at the very moment of their emission from the crater, I could perceive a bright but pale electrical fire playing about in zigzag lines.

THROWN UPWARD THOUSANDS OF FEET.

"The liquid lava, mixed with scorice and stones, after having mounted, I veritably believe at least 10,000 feet, falling perpendicularly on Vesuvius, covered its whole cone, part of that of Somma, and the valley between them. The falling matter being nearly as vivid and inflamed as that which was continually issuing fresh from the crater, formed with it one complete body of fire, which could not be less than two miles and a half in breadth, and of the extraordinary height above mentioned; casting a heat to the distance of at least six miles around it.

"The brushwood of the mountain of Somma was soon in flame, which, being of a different tint from the deep red of the matter thrown out from the volcano, and from the silvery blue of the electrical fire, still added to the contrast of this most extraordinary scene. After the column of fire had continued in full force for nearly half an hour, the eruption ceased at once, and Vesuvius remained sullen and silent."

The lightnings here described arose evidently in part from the chemical activity of gaseous decompositions going forward, in part to the friction of steam, and in part from the still more intense friction of the dust, stones and ashes encountering one another in the air, in analogy to the electric manifestations which accompany the dust storms in India.

To give an idea of the state of the inhabitants of the country when an explosion is going on, I will make one other extract:—"The mountain of Somma, at the foot of which Ottaiano is situated, hides Vesuvius from its sight, so that, until the eruption became considerable, it was not visible to them. On Sunday night, when the noise increased and the fire began to appear above the mountain of Somma, many of the inhabitants of the town flew to the churches, and others were preparing to quit the town, when a sudden violent report was heard, soon after which they found themselves involved in a thick cloud of smoke and minute ashes; a horrid clashing noise was heard in the air, and presently fell a deluge of stones and large scoriæ, some of which scoriæ were of the diameter of seven or eight feet, and must have weighed more than one hundred pounds before they were broken by their falls, as some of the fragments of them which I picked up in the streets still weighed upwards of sixty pounds.

GLEAMING SPARKS OF FIRE.

"When the large vitrified masses either struck against each other in the air or fell on the ground, they broke in many pieces, and covered a large space around them with vivid sparks of fire, which communicated their heat to everything that was combustible. In an instant the town and country about it was on fire in many parts; for in the vineyards there were several straw huts which had been erected for the watchmen of the grapes, all of which were burnt. A great magazine of wood in the heart of the town was all in a blaze, and had there been much wind, the flames must have spread universally, and all the inhabitants would have infallibly been burnt in their houses, for it was impossible for them to stir out.

"Some who attempted it with pillows, tables, chairs, tops of wine casks, etc., on their heads, were either knocked down or driven back to their close quarters under arches or in the cellars of the houses. Many were wounded, but only two persons have died of the wounds they received from this dreadful volcanic shower. To add to the horror of the scene, incessant volcanic lightning was

writhing about the black cloud that surrounded them, and the sulphurous smell and heat would scarcely allow them to draw their breath."

The next volcano I shall introduce is *Ætna*, the grandest of all our European volcanoes. I ascended it in 1824, and found its height by a very careful barometric measurement to be 10,772 feet above the sea, which, by the way, agrees within some eight or ten feet with Admiral Smyth's measurement.

The scenery of *Ætna* is on the grandest scale. Ascending from Catania you skirt the stream of lava which destroyed a part of that city in 1669, and which ran into the sea, forming a jetty or breakwater that now gives Catania what it never had before, the advantage of a harbor. There it lies as hard, rugged, barren, and fresh-looking as if it had flowed but yesterday. In many places it is full of huge caverns; great air-bubbles, into which one may ride on horseback (at least large enough) and which communicate, in a succession of horrible vaults, where one might wander and lose one's self without hope of escape.

BRISTLING WITH SMALL VOLCANOES.

Higher up, near Nicolosi, is the spot from which that lava flowed. It is marked by two volcanic cones, each of them a considerable mountain, called the Monti Rossi, rising 300 feet above the slope of the hill, and which were thrown up on that occasion. Indeed, one of the most remarkable features of *Ætna* is that of its flanks bristling over with innumerable smaller volcanoes. For the height is so great that the lava now scarcely ever rises to the top of the crater; for before that, its immense weight breaks through at the sides.

In one of the eruptions that happened in the early part of the century, I forget the date, but I think it was in 1819, and which was described to me on the spot by an eye-witness—the Old Man of the Mountain, Mario Gemellaro—the side of *Ætna* was rent by a great fissure or crack, beginning near the top, and throwing out jets of lava from openings fourteen or fifteen in number all the way down, so as to form a row of fiery fountains rising from dif-

ferent levels, and all ascending nearly to the same height : thereby proving them all to have originated in the great internal cistern as it were, the crater being filled up to the top level.

From the summit of *Ætna* extends a view of extraordinary magnificence. The whole of Sicily lies at your feet, and far beyond it are seen a string of lesser volcanoes; the Lipari Islands, between Sicily and the Italian coast; one of which, *Stromboli*, is always in eruption, unceasingly throwing up ashes, smoke, and liquid fire.

But I must not linger on the summit of *Ætna*. We will now take a flight thence, all across Europe, to Iceland—a wonderful land of frost and fire. It is full of volcanoes, one of which, *Hecla*, has been twenty-two times in eruption within the last 800 years. Besides *Hecla*, there are five others, from which in the same period twenty eruptions have burst forth, making about one every twenty years. The most formidable of these was that which happened in 1783, a year also memorable as that of the terrible earthquake in Calabria. In May of that year, a bluish fog was observed over the mountain called *Skaptur Jokul*, and the neighborhood was shaken by earthquakes.

DARKENED THE WHOLE COUNTRY.

After a while a great pillar of smoke was observed to ascend from it, which darkened the whole surrounding district, and descended in a whirlwind of ashes. On the 10th of May, innumerable fountains of fire were seen shooting up through the ice and snow which covered the mountain; and the principal river, called the *Skapta*, after rolling down a flood of foul and poisonous water, disappeared.

Two days after, a torrent of lava poured down into the bed which the river had deserted. The river had run in a ravine, 600 feet deep and 200 broad. This the lava entirely filled; and not only so, but it overflowed the surrounding country, and ran into a great lake, from which it instantly expelled the water in an explosion of steam. When the lake was fairly filled, the lava again overflowed and divided into two streams, one of which covered some

ancient lava fields; the other re-entered the bed of the Skapta lower down; and presented the astounding site of a cataract of liquid fire pouring over what was formerly the waterfall of Stapafoss.

This was the greatest eruption on record in Europe. It lasted in its violence till the end of August, and closed with a violent earthquake; but for nearly the whole year a canopy of cinder-laden cloud hung over the island; the Faroe Islands, nay, even Shetland and the Orkneys, were deluged with the ashes; and volcanic dust and a preternatural smoke, which obscured the sun, covered all Europe as far as the Alps, over which it could not rise.

GREAT DESTRUCTION OF LIFE.

It has been surmised that the great Fireball of August 18, 1783, which traversed all England, and the Continent, from the North Sea to Rome, by far the greatest ever known (for it was more than half a mile in diameter), was somehow connected with the electric excitement of the upper atmosphere produced by this enormous discharge of smoke and ashes. The destruction of life in Iceland was frightful; 9000 men, 11,000 cattle, 28,000 horses and 190,000 sheep perished: mostly by suffocation. The lava ejected has been computed to have amounted in volume to more than twenty cubic miles.

We shall now proceed to still more remote regions, and describe, in as few words as may be, two immense eruptions—one in Mexico, in the year 1759; the other in the Island of Sumbawa in the Eastern Archipelago, in 1815.

I ought to mention, by way of preliminary, that almost the whole line of coast of South and Central America, from Mexico southwards as far as Valparaiso—that is to say, nearly the whole chain of the Andes—is one mass of volcanoes. In Mexico and Central America there are two and twenty, and in Quito, Peru, and Chili, six and twenty more, in activity; and nearly as many more extinct ones, any one of which may at any moment break out afresh. This does not prevent the country from being inhabited, fertile and well cultivated.

Well : in a district of Mexico celebrated for the growth of the finest cotton, between two streams called Cuitimba and San Pedro, which furnished water for irrigation, lay the farm and homestead of Don Pedro de Jurullo, one of the richest and most fertile properties in that country. He was a thriving man and lived in comfort as a large proprietor, little expecting the mischief that was to befall him.

In June 1759, however, a subterranean noise was heard in this peaceful region. Hollow sounds of the most alarming nature were succeeded by frequent earthquakes, succeeding one another for fifty or sixty days ; but they died away, and in the beginning of September everything seemed to have returned to its usual state of tranquillity. Suddenly, on the night of the 28th of September, the horrible noises recommenced. All the inhabitants fled in terror, and the whole tract of ground, from three to four square miles in extent, rose up in the form of a bladder to a height of upwards of 500 feet.

IMMENSE TORRENT OF BOILING MUD.

Flames broke forth over a surface of more than half a square league, and through a thick cloud of ashes illuminated by this ghastly light, the refugees, who had ascended a mountain at some distance, could see the ground as if softened by the heat, and swelling and sinking like an agitated sea. Vast rents opened in the earth, into which the two rivers I mentioned precipitated themselves, but so far from quenching the fires, only seemed to make them more furious. Finally, the whole plain became covered with an immense torrent of boiling mud, out of which sprang thousands of little volcanic cones called Hornitos, or ovens.

But the most astonishing part of the whole was the opening of a chasm vomiting out fire, and red-hot stones and ashes, which accumulated so as to form "a range of six large mountain masses, one of which is upwards of 1600 feet in height above the old level, and which is now known as the volcano of Jurullo. It is continually burning, and for a whole year continued to throw up

an immense quantity of ashes, lava and fragments of rock. The roofs of houses at the town or village of Queretaro, upwards of 140 miles distant, were covered with the ashes.

The two rivers have again appeared, issuing at some distance from among the hornitos, but no longer as sources of wealth and fertility, for they are scalding hot, or at least were so when Baron Humboldt visited them several years after the event. The ground even then retained a violent heat, and the hornitos were pouring forth columns of steam twenty or thirty feet high, with a rumbling noise like that of a steam boiler.

The island of Sumbawa is one of that curious line of islands which links on Australia to the southeastern corner of Asia. It forms, with one or two smaller volcanic islands, a prolongation of Java, at that time, in 1815, a British possession, and under the government of Sir Stamford Raffles, to whom we owe the account of the eruption, and who took a great deal of pains to ascertain all the particulars. Java itself, I should observe, is one rookery of volcanoes, and so are all the adjoining islands in that long crescent-shaped line I refer to.

EXTRAORDINARY ERUPTION.

On the island of Sumbawa is the volcano of Tomboro, which broke out into eruption on the 5th of April in that year, and I can hardly do better than quote the account of it in Sir Stamford Raffles' own words:

"Almost every one," says this writer, "is acquainted with the intermitting convulsions of Etna and Vesuvius as they appear in the descriptions of the poet, and the authentic accounts of the naturalist; but the most extraordinary of them can bear no comparison, in point of duration and force, with that of Mount Tomboro in the island of Sumbawa! This eruption extended perceptible evidences of its existence over the whole of the Molucca Islands, over Java, a considerable portion of the Celebes, Sumatra and Borneo, to a circumference of 1000 statute miles from its centre" (i. e., to 1000 miles distance), "by tremulous motions and the report of explosions.

"In a short time the whole mountain near the Sang'ir appeared like a body of liquid fire, extending itself in every direction. The fire and columns of flame continued to rage with unabated fury until the darkness, caused by the quantity of falling matter, obscured it about 8 P. M. Stones at this time fell very thick at Sang'ir, some of them as large as two fists, but generally not larger than walnuts. Between 9 and 10 P. M. ashes began to fall, and soon after a violent whirlwind ensued, which blew down nearly every house of Sang'ir, carrying the roofs and light parts away with it.

HUGE TREES TORN UP.

"In the port of Sang'ir, adjoining Sumbawa, its effects were much more violent, tearing up by the roots the largest trees, and carrying them into the air, together with men, horses, cattle, and whatsoever came within its influence. This will account for the immense number of floating trees seen at sea. The sea rose nearly twelve feet higher than it had ever been known to do before, and completely spoiled the only small spots of rice land in Sang'ir, sweeping away houses and everything within its reach. The whirlwind lasted about an hour. No explosions were heard until the whirlwind had ceased at about 11 P. M. From midnight till the evening of the 11th they continued without intermission; after that time their violence moderated and they were heard only at intervals; but the explosions did not cease entirely until the 15th of July.

"Of all the villages round Tomboro, Tempo, containing about forty inhabitants, is the only one remaining. In Pekaté no vestige of a house is left; twenty-six of the people, who were at Sumbawa at the time, are the whole of the population who have escaped. From the best inquiries, there were certainly not fewer than 12,000 individuals in Tomboro and Pekaté at the time of the eruption, of whom five or six survive.

"The trees and herbage of every description along the whole of the north and west of the peninsula, have been completely destroyed, with the exception of a high point of land near the spot

where the village of Tomboro stood. At Sang'ir, it is added, the famine occasioned by this event was so extreme, that one of the rajah's own daughters died of starvation.

"I have seen it computed that the quantity of ashes and lava vomited forth in this awful eruption would have formed three mountains the size of Mont Blanc, the highest of the Alps; and if spread over the surface of Germany, would have covered the whole of it two feet deep. The ashes did actually cover the whole island of Tombock, more than one hundred miles distant, to that depth, and 44,000 persons there perished by starvation, from the total destruction of all vegetation.

LAKE OF MOLTEN LAVA.

"The mountain Kirauiah, in the island of Owyhee, one of the Sandwich Isles, exhibits the remarkable phenomenon of a lake of molten and very liquid lava always filling the bottom of the crater, and always in a state of terrific ebullition, rolling to and fro its fiery surge and flaming billows—yet with this it is content, for it would seem that at least for a long time past there has been no violent outbreak so as to make what is generally understood by a volcanic eruption.

"Volcanic eruptions are almost always preceded by earthquakes, by which the beds of rock, that overlie and keep down the struggling powers beneath, are dislocated and cracked, till at last they give way, and the strain is immediately relieved. It is chiefly when this does not happen, when the force below is sufficient to heave up and shake the earth, but not to burst open the crust, and give vent to the lava and gases, that the most destructive effects are produced.

"The great earthquake of November 1, 1755, which destroyed Lisbon, was an instance of this kind, and was one of the greatest, if not the very greatest on record; for the concussion extended over all Spain and Portugal—indeed, over all Europe, and even into Scotland—over North Africa, where in one town in Morocco 8000 or 10,000 people perished. Nay, its effects extended even across the Atlantic to Madeira, where it was very violent; and to

the West Indies. The most striking feature about this earthquake was its extreme suddenness.

"All was going on quite as usual in Lisbon the morning of that memorable day, the weather fine and clear, and nothing whatever to give the population of that great capital the least suspicion of mischief. All at once, at twenty minutes before 10 A. M., a noise was heard like the rumbling of carriages under ground; it increased rapidly and became a succession of deafening explosions like the loudest cannon. Then a shock, which, as described by one writing from the spot, seemed to last but the tenth part of a minute, and down came tumbling palaces, churches, theatres, and every large public edifice, and about a third or a fourth part of the dwelling houses.

More shocks followed in succession, and in six minutes from the commencement 60,000 persons were crushed in the ruins! Here are the simple but expressive words of one J. Latham, who writes to his uncle in London. "I was on the river with one of my customers going to a village three miles off. Presently the boat made a noise as if on the shore or landing, though then in the middle of the water. I asked my companion if he knew what was the matter. He stared at me, and looking at Lisbon, we saw the houses falling, which made him say, 'God bless us, it is an earthquake!' About four or five minutes after, the boat made a noise as before, and we saw the houses tumble down on both sides of the river." They then landed and made for a hill, whence they beheld the sea (which had at first receded and laid a great tract dry) come rolling in, in a vast mountain wave fifty or sixty feet high, on the land, and sweeping all before it.

Three thousand people had taken refuge on a new stone quay just completed at great expense. In an instant it was turned topsy-turvy, and the whole quay, and every person on it, with all the vessels moored to it, disappeared, and not a vestige of them ever appeared again. Where that quay stood, was afterwards found a depth of 100 fathoms (600 feet) of water. It happened to be a religious festival, and most of the population were assembled in the churches, which fell and crushed them. That no horror

might be wanting, fires broke out in innumerable houses where wood-work had fallen on the fires, and much that the earthquake had spared was destroyed by fire.

“And then, too, broke forth that worst of all scourges, a lawless ruffian-like mob, who plundered, burned, and murdered in the midst of all that desolation and horror. The huge wave I have spoken of swept the whole coast of Spain and Portugal. Its swell and fall was ten or twelve feet at Madeira. It swept quite across the Atlantic, and broke on the shores of the West Indies. Every lake and firth in England and Scotland was dashed for a moment out of its bed, the water not partaking of the sudden shove given to the land, just as when you splash a flat saucerful of water, the water dashes over on the side from which the shock is given.

One of the most curious incidents in this earthquake was its effect on ships far out at sea, which would lead us to suppose that the immediate impulse was in the nature of a violent blow or thrust upward, under the bed of the ocean. Thus it is recorded that this upward shock was so sudden and violent on a ship, at that time forty leagues from Cape St. Vincent, that the sailors on deck were tossed up into the air to a height of eighteen inches.

MAINMAST SPLIT BY A BLOW.

“So also, on another occasion, in 1796, a British ship eleven miles from land near the Philippine Islands was struck upwards from below with such force as to unship and split up the mainmast.

“Evidences of a similar sudden and upward explosive action are of frequent occurrence among the extinct volcanoes of Auvergne and the Vivarais, where in many instances the perforation of the granitic beds which form the basis or substratum of the whole country appears to have been affected at a single blow, accompanied with little evidence of disturbance of the surrounding rocks—much in the same way as a bullet will pass through a pane of glass without starring or shattering it.

“In such cases it would seem as if water in a liquid state

had suddenly been let in through a fissure upon a most intensely heated and molten mass beneath, producing a violent but local explosion so instantaneous as to break its way through the overlying rocks, without allowing time for them to bend or crumple, and so displace the surrounding masses.

"The same kind of upward bounding movement took place at Riobambo in Quito in the great earthquake of February 4, 1797, which was connected with an eruption of the volcano of Tunguragua. That earthquake extended in its greatest intensity over an oval space of 120 miles from south to north, and 60 from east to west, within which space every town and village was levelled with the ground; but the total extent of surface shaken was upward of 500 miles in one direction (from Puna to Popayan), and 400 in the other. Quero, Riobamba, and several other towns, were buried under fallen mountains, and in a very few minutes 30,000 persons were destroyed. At Riobamba, however, after the earthquake, a great number of corpses were found to have been tossed across a river, and scattered over the slope of a hill on the other side.

EARTH SHAKING VIOLENTLY.

"The frequency of these South American earthquakes is not more extraordinary than the duration of the shocks. Humboldt relates that on one occasion, when traveling on mule-back with his companion Bonpland, they were obliged to dismount in a dense forest, and throw themselves on the ground; the earth being shaken uninterruptedly for upwards of a quarter of an hour with such violence that they could not keep their legs.

"One of the most circumstantially described earthquakes on record is that which happened in Calabria on the 5th of February, 1783; I should say began then, for it may be said to have lasted four years. In the year 1783, for instance, 949 shocks took place, of which 501 were great ones, and in 1784, 151 shocks were felt, ninety-eight of which were violent. The centre of action seemed to be under the towns of Monteleone and Oppido.

"In a circle twenty-two miles in radius round Oppido every town and village was destroyed within two minutes by the first

shock, and within one of seventy miles radius all were seriously shaken and much damage done. The whole of Calabria was affected, and even across the sea Messina was shaken, and a great part of Sicily.

“There is no end of the capricious and out-of-the-way accidents and movements recorded in this Calabrian earthquake. The ground undulated like a ship at sea. People became actually sea-sick, and to give an idea of the undulation (just as it happens at sea), the scud of the clouds before the wind seemed to be fitfully arrested during the pitching movement when it took place in the same direction and to redouble its speed in the reverse movement.

HOUSES ENTOMBED.

“At Oppido many houses were swallowed up bodily. Loose objects were tossed up several yards into the air. The flagstones in some places were found after a severe shock all turned bottom upwards. Great fissures opened in the earth, and at Terra Nova a mass of rock 200 feet high and 400 feet in diameter traveled four miles down a ravine. All landmarks were removed, and the land itself, in some instances, with trees and hedges growing on it, carried bodily away and set down in another place.

“Altogether about 40,000 people perished by the earthquakes, and some 20,000 more of the epidemic diseases produced by want and the effluvia of the dead bodies.

“Volcanoes occasionally break forth at the bottom of the sea, and, when this is the case, the result is usually the production of a new island. This, in many cases, disappears soon after it's formation, being composed of loose and incoherent materials which easily yield to the destructive power of the waves. Such was the case with the Island of Sabrina, thrown up in 1811, off St. Michael's, in the Azores, which disappeared almost as soon as formed, and in that of Pantellaria, on the Sicilian coast, which resisted longer, but was gradually washed into a shoal, and at length has, we believe, completely disappeared.

“In numerous other instances, the cones of cinders and scorïæ, once raised, have become compacted and bound together

by the effusion of lava, hardening into solid stone, and thus, becoming habitual volcanic vents, they continue to increase in height and diameter, and assume the importance of permanent volcanic islands. Such has been, doubtless, the history of those numerous insular volcanoes which dot the ocean in so many parts of the world such as Teneriffe, the Azores, Ascension, St. Helena, Tristan d'Acunha, etc.

"In some cases the process has been witnessed from its commencement, as in that of two islands which arose in the Aleutian group connecting Kamschatka with North America, the one in 1796, the other in 1814, and which both attained the elevation of 3000 feet.

VOLCANIC ACTION IN OCEANS.

"Besides these evident instances of eruptive action, there is every reason to believe that enormous floods of lava have been, at various remote periods in the earth's history, poured forth at the bottom of the seas so deep as to repress, by the mere weight of water, all outbreak of steam, gas, or ashes; and reposing perhaps for ages in a liquid state, protected from the cooling action of the water on their upper surface by a thick crust of congealed stony matter, to have assumed a perfect level; and, at length, by slow cooling, taken on that peculiar columnar structure which we see produced in minature in starch by the contraction or shrinkage, and consequent splitting, of the material in drying; and resulting in those picturesque and singular landscape features called basaltic colonnades: when brought up to-day by sudden or gradual upheaval, and broken into cliffs and terraces by the action of waves, torrents, or weather. Those grand specimens of such colonnades which Britain possesses in the Giant's Causeway of Antrim, and the cave of Fingal, in Staffa, for instance, are no doubt extreme outstanding portions of such a vast submarine lava-flood which at some inconceivably remote epoch occupied the whole intermediate space; affording the same kind of evidence of a former connection of the coasts of Scotland and Ireland as do the opposing chalk cliffs of Dover and Boulogne of the ancient connection of France with Britain. Here and there a small basaltic

island, such as that of Rathlin, remains to attest this former continuity, and to recall to the contemplative mind that sublime antagonism between sudden violence and persevering effort, which the study of geology impresses in every form of repetition.

"There exists a very general impression that earthquakes are preceded and ushered in by some kind of preternatural, and,



NEAR VIEW OF A VOLCANIC CRATER IN SOUTH AMERICA.

as it were, expectant calm in the elements; as if to make the confusion and desolation they create the more impressive. The records of such visitations which we possess, however striking some particular cases may appear, by no means bear out this as a general fact, or go to indicate any particular phase of weather as preferentially accompanying their occurrence.

"This does not prevent, however, certain conjunctures of atmospheric or other circumstances from exercising a determining

influence on the times of their occurrence. According to the view we have taken of their origin (*viz.*, the displacement of pressure, resulting in a state of strain in the strata at certain points, gradually increasing to the maximum they can bear without disruption), it is the last ounce which breaks the camel's back. Great barometrical fluctuation, accumulating atmospheric pressure for a time over the sea, and relieving it over the land; an unusually high tide, aided by the long-continued and powerful winds heaping up the water; nay, even the tidal action of the sun and moon on the solid portion of the earth's crust—all these causes, for the moment combining, may very well suffice to determine the instant of fracture, when the balance between the opposing forces is on the eve of subversion.

"The last-mentioned cause may need a few words of explanation. The action of the sun and moon, though it cannot produce a tide in the solid crust of the earth, tends to do so, and, were it fluid, would produce it. It, therefore, in point of fact, does bring the solid portions of the earth's surface into a state alternately of strain and compression.

"The effective part of their force, in the present case, is not that which aids to lift or to press the superficial matter (for that acting alike on the continents and on the bed of the sea, would have no influence), but that which tends to produce lateral displacement; or what geometers call the tangential force. This of necessity brings the whole ring of the earth's surface, which at any instant has the acting luminary on its horizon, into a state of strain; and the whole area over which it is nearly vertical, into one of compression. We leave this point to be further followed out, but we cannot forbear remarking, that the great volcanic chains of the world have, in point of fact, a direction which this cause of disruption would tend rather to favor than to contravene.

CHAPTER XIX.

ERUPTION OF ETNA IN THE YEAR 1865.—MUTUAL DEPENDENCE OF ALL TERRESTRIAL PHENOMENA.—SEA COAST LINE OF VOLCANOES.—THE PACIFIC "CIRCLE OF FIRE."

THE Greek mythology, harmonizing in this respect with the ideas of most nations which were acquainted with volcanoes, attributed to these mountains an origin altogether independent of the forces which are in action on the surface of the ground. According to the views of the Hellenes, water and fire were two distinct elements, and each had its separate domain, its genii, and its gods. Neptune reigned over the sea ; it was he that unchained the storms and caused the waves to swell. The tritons followed in his train ; the nymphs, sirens, and marine monsters obeyed his orders, and in the mountain valleys, the solitary naiads poured out to his honor the murmuring water from their urns. In the dark depth of unknown abysses was enthroned the gloomy Pluto ; at his side Vulcan ; surrounded by Cyclops, forged thunderbolts at his resounding anvil, and from their furnaces escaped all the flames and molten matter the appearance of which so appalled mankind. Between the gods of water and of fire there was nothing in common, except that both were the sons of Chronos, that is, of Time, which modifies every thing, which destroys and renews, and, by its incessant work of destruction, makes ready a place for the innumerable germs of vitality which crowd on the threshold of life.

Even in our days, the common opinion is not much at variance with these mythological ideas, and volcanic phenomena are looked upon as events of a character altogether different from other facts of terrestrial vitality. The latter, the sudden changes of which are visible and easily to be observed, are justly considered to be owing principally to the position of the earth in respect to the sun and the alternations of light and darkness, heat and cold, dryness and moisture, which necessarily result.

As regards volcanoes, on the contrary, an order of entirely distinct facts is imagined, caused by the gradual cooling of the planet or the unequal tides of an ocean of lava and fire. Certainly, the eruptions of ashes and incandescent matter have not revealed the mystery of their formation, and in this respect numerous problems still remain unsolved by scientific men. Nevertheless, the facts already known warrant us in asserting that volcanic crises are connected, like all other planetary phenomena, with the general causes which determine the continual changes of continents and seas, the erosion of mountains, the courses of rivers, winds, and storms, the movements of the ocean, and all the innumerable modifications which are taking place on the globe.

ORIGIN OF VOLCANOES.

If, some day, we are to succeed in pointing out exactly and plainly how volcanoes likewise obey, either partially or completely, the system of laws which govern the exterior of the globe, the first and most important requisite is to observe with the greatest care all the incidents of volcanic origin. When all the premonitory signs and all the products of eruptions shall have been perfectly ascertained and duly classified, then the glance of science will be on the point of penetrating into, and duly reading, the secrets of the subterranean abysses where these marvelous convulsions are being prepared.

The last great eruption of Etna, that central pyramid of the Mediterranean, which the ancients named the "Umbilicus of the world," is one of the most magnificent examples which can be brought forward of volcanic phenomena ; and as it has, moreover, been studied most precisely and completely, it well deserves to be described in some detail.

The explosion had been heralded for some long time by precursory signs. In the month of July, 1863, after a series of convulsive movements of the soil, the loftiest cone of the volcano opened on the side which faces the south. The incandescent matter descended slowly over the plateau on which stands the "Maison des Anglais : " and this building itself was demolished

by the lumps of lava which were hurled from the mouth of the crater. In some places heaps of ashes several yards thick covered the slopes of the volcano.

After this first explosion, the mountain never became completely calm ; numerous fissures, which opened on the outer slopes of the crater, continued to smoke, and the hot vapor never ceased to jet out from the summit in thick eddies. Often, indeed, during the night, the reflection of the lava boiling up in the central cavity lighted up the atmosphere with a fiery red. The liquid, being unable to rise to the mouth of the crater, pressed against the external walls of the volcano, and sought to find an issue through the weakest point of the crust by melting gradually the rocks that opposed its passage.

GROUND RENT ASUNDER.

Finally, in the night of the 30th to the 31st of January, 1865, the wall of the crater yielded to the pressure of the lava ; some subterranean roaring was heard ; slight agitations affected the whole of the eastern part of Sicily, and the ground was rent open for the length of a mile and a half to the north of Monte Frumento, one of the secondary cones which rise on the slope of Etna. Through this fissure, which opened on a gently-inclined plateau, the pent-up lava violently broke through to the surface.

The fissure which opened on the side of the mountain, and could be easily followed by the eye to a point about two-thirds of the height of Monte Frumento, in the direction of the terminal crater of Etna, seems to have vomited out lava but for a very few hours. Being soon obstructed by the snow and debris of the adjacent slopes, it ceased to retain its communication with the interior of the mountain, and now resembled a kind of furrow, as if hollowed out by the rain-water on the side of the cone. On the 31st of January all the volcanic activity of the crevice was concentrated on the gently inclined plateau which extends at the base of Monte Frumento, in the midst of which several new hillocks made their appearance.

On the lower prolongation of the line of fracture, all the

phenomena of the eruption properly so-called were distributed in a perfectly regular way. Six principal cones of ejection were raised above the crevice, and gradually increased in size, owing to the debris which they threw out of their craters. These, gradually mingling their intervening slopes, and blending them one with another, absorbed in succession other smaller cones which had been formed by their sides, thus reaching a height of nearly 300 feet. Soon after the commencement of the eruption the two upper craters, standing close together on an isolated cone, vomited nothing but lumps of stone and ashes, while jets of still liquid lava were emitted by the lower craters, which were arranged in a semi-circle around a sort of funnel-shaped cavity.

HOW LAVA MADE ITS ESCAPE.

In consequence of the specific gravities of the substances evacuated, a regular division of labor took place between the various points of the crevice. The projectiles which had solidified the triturated debris, and the more or less porous fragments which floated on the top of the lava, made their escape by the higher orifices; but the liquid mass, being heavier and more compact, could only burst forth from the ground by the mouths opening at a less elevation.

Two months after the commencement of the eruption, the cone which was the nearest to Frumento ceased to send out either scoriæ or ashes. The pipe of the crater was filled up with debris, and the internal activity was revealed by vapors either of a sulphurous character or charged with hydrochloric acid. These rose like smoke from the slope of the hillock. The second cone, situated on a lower part of the fissure, remained in direct communication with the central flow of lava; but it was not in a constant state of eruption, and rested after each effort as if to take breath. A crash like that of thunder was the forerunner of the explosion; clouds of vapor, rolling in thick folds, gray with ashes and furrowed with stones, darted out from the mouth of the volcano, darkening the atmosphere and throwing their projectiles over a radius of several hundreds of yards round the hillock.

Then, after having discharged their burdens of debris, the dark clouds, giving way to the pressure of the winds, mingled far and wide with the mists of the horizon. The lower cones, which rose immediately over the lava-source, continued to rumble and discharge molten matter outside their cavities. The vapor which escaped from the seething wall of lava crowded in dark contortions round the orifice of the craters. Some of it was red or yellow, owing to the reflection of the red-hot matter, and some was variously shaded by the trains of debris ejected with it; but it was impossible to follow them with the eye so rapid was their flight. An unintelligible tumult of harsh sounds simultaneously burst forth. They were like the noises of saws, whistles, and of hammers falling on an anvil. Sometimes one might have fancied it like the roaring of the waves breaking upon the rocks during a storm, if the sudden explosions had not added their thunder to all this uproar of the elements.

HILLS ROARING AND SMOKING.

One felt dismayed, as if before some living being, at the sight of these groups of hillocks, roaring and smoking, and increasing in size every hour, by the debris which they vomited forth from the interior of the earth. The volcano, however, then commenced to rest; the erupted matter did not rise much beyond 100 yards above the craters, while, according to the statement of M. Fouqué, at the commencement of the eruption it had been thrown to a height of 1850 to 1950 yards.

During the first six days the quantity of lava which issued from the fissure of Monte Frumento was estimated at 117 cubic yards a second, equivalent to a volume twice the bulk of the Seine at low-water time. In the vicinity of the outlets the speed of the current was not less than twenty feet a minute; but lower down, the stream, spreading over a wider surface, and throwing out several branches into the side valleys, gradually lost its initial speed, and the fringes of scorixæ, which were pushed on before the incandescent matter, advanced, on the average, according to the slope of the ground, not more than one and a half to six feet a minute.

On the second of February the principal current, the breadth of which varied from 300 to 550 yards, with an average thickness of forty-nine feet, reached the upper ledge of the escarpment of Colla-Vecchia, or Colla-Grande, three miles from the fissure of eruption, and plunged like a cataract into the gorge below. It was a magnificent spectacle, especially during the night, to see this sheet of molten matter, dazzling red like liquid iron, making its way, in a thin layer, from the heaps of brown scoriæ which had gradually accumulated up above; then, carrying with it the more solid lumps, which dashed one against the other with a metallic noise, it fell over into the ravine, only to rebound in stars of fire.

ITS BEAUTY FINALLY FADED.

But this splendid spectacle lasted only for a few days; the fiery fall, by losing in height, diminished gradually in beauty. In front of the cataract, and under the jet itself, there was formed an incessantly increasing slope of lava, which ultimately filled up the ravine, and, indeed, prolonged the slope of the valley above. From the reservoir, which was more than 160 feet deep, the stream continued to flow to the east toward Mascali, filling up to the brink the winding gorge of a dried up rivulet.

By the middle of the month of February, the fiery stream, already more than six miles long, made but very slow progress, and the still liquid lava found it difficult to clear an outlet through the crust of stones cooled by their contact with the atmosphere; when, all of a sudden, a breaking out took place at the side of the stream, at a point some distance up, not far from the source. Then a fresh branch of the burning river, flowing toward the plains of Linguagrossa, swallowed up thousands of trees which had been felled by the woodman.

This second inundation of lava did not, however, last long. The villages and towns situated at the base of the mountain were no longer directly menaced; but the disasters caused by the eruption were, notwithstanding, very considerable. A number of farm-houses were swept away; vast tracts of pasturage and cultivated ground were covered by slowly hardening rock, and—a

misfortune which was all the worse on account of the almost general deforesting of Sicily—a wide band of forest, comprising, according to the various estimates that were made, from 100,000 to 130,000 trees—oaks, pines, chestnuts, or birches—was completely destroyed.

When seen from the lower part of the mountain, all these burning trunks borne along upon the lava, as if upon a river of fire, singularly contributed to the beauty of the spectacle. As is always the case in the events of this world, the misfortune of some proved to be a source of gratification to others. During the earliest period of the eruption, while the villagers of Etna looked at it with stupor, and were bitterly lamenting over the destruction of their forests, hundreds of curious spectators, brought daily by the steamboats from Catania and Messina, came to enjoy at their ease the contemplation of all the splendid horrors of the conflagration.

PYRAMIDS AND TWISTED COLUMNS.

The aspect of the current of lava, as it appeared covered with its envelope of scoriæ, was scarcely less remarkable than the sight of the matter in motion. The black or reddish aspect of the cheire was all roughened with sharp-edged projections, which resembled steps, pyramids or twisted columns, on which it was a difficult matter to venture, except at the risk of tearing the feet and hands. Some months after the commencement of the eruption, the onward motion of the interior of the molten stone, which, by breaking the outer crust in every direction, had ultimately given it this rugged outline, was still visibly taking place. Here and there cracks in the rock allowed a view, as if through an air-hole, of the red and liquid lava swelling up as it flowed gently along like some viscous matter.

A metallic clinking sound was incessantly heard, proceeding from the fall of the scoriæ, which were breaking under the pressure of the liquid matter. Sometimes, on the hardening current of lava, a kind of blister gradually rose, which either opened gently, or bursting with a crash gave vent to the molten mass which formed it. Fumerolles, composed of various gases, according to the degree of heat of the lava which gave rise to them, jetted

out from all the issues. Even on the banks of the river of stone the soil was in many places all burning and pierced with crevices, through which escaped a hot air thoroughly charged with the smell of burnt roots.

On the slopes of Frumento, quite close to the upper part of the fissure, at a spot where the liquid mass had flowed like a torrent, M. Fouqué noticed a remarkable phenomenon; sheaths of solidified lava were surrounding the trunks of pines, and thus showing the height to which the current of molten stone had reached.

In like manner, the streams of obsidian which flow rapidly from the basin of Kilauea, in the isle of Hawaii, leave behind them on the branches of the trees numerous stalactites like the icicles which are formed by melting snow which has again frozen. Below the escarpments of the Frumento, the torrent, which was there retarded in its progress, had not contented itself with bathing for a moment the trunks of the forest trees, but had laid them low. Great trunks of trees, broken down by the lava, lay stretched in disorder on the uneven bed of the stream, and, although they were only separated from the molten matter by a crust a few inches thick, numbers of them were still clothed with their bark; several had even preserved their branches.

PINE TREES AND FIRS.

At the edge of the cheire, some pine trees, which had perhaps been preserved from the fire by the moisture being converted by the heat into a kind of coating of steam, were surrounded by a wall of heaped up lava, and their foliage still continued green; it could not yet be ascertained if the sources of the sap had perished in their roots.

In some places, rows of firs very close together were sufficient to change the direction of the flow, and to cause a lateral deviation. Not far from the crater of eruption, on the western bank of the great cheire, a trunk of a tree was noticed which by itself had been able to keep back a branch of the stream, and to prevent it from filling up the glen which opened immediately below.

This tree being thrown down by the weight of the scoriæ, had

fallen so as to bar up a slight depression in the ground which presented a natural bed to the molten matter. The latter had bent and cracked the trunk, but had failed in breaking it, and the stony torrent had remained suspended, so to speak, above the beautiful wooden slopes which it threatened to destroy completely.

Round the very mouth of the volcano, a vast glade was formed in the forest; the ground was covered everywhere with ashes which the wind had blown into hillocks, like the dunes on the sea coast; all the trees had been broken down by the volcanic projectiles, and burned by the scoriæ and small stones. The nearest trees that were met with, at unequal distances from the mouths of eruption, had had their branches torn off by the falling lumps of stone, or were buried in ashes up to their terminal crown.

SEVENTY-FIVE RECORDED ERUPTIONS.

A spectator might have walked among a number of yellow branches which were once the tops of lofty pines. Thus, on the plateau of Frumento and the lower slopes, everything was changed both in form and aspect; we might justly say that, by the effects of the erupted matter, the outline of the sides of Etna itself had been perceptibly modified.

And yet this last eruption, one of the most important in our epoch, is but an insignificant episode in the history of the mountain; it was but a mere pulsation of Etna. During the last twenty centuries only, more than seventy-five eruptions have taken place, and in some of them the flows of lava have been more than twelve miles in length, and have covered areas of more than forty square miles, which were once in a perfect state of cultivation, and dotted over with towns and villages. In former ages, thousands of other lava-flows and cones of ashes have gradually raised and lengthened the slopes of the mountain.

The mass of Mount Etna, the total bulk of which is three or four thousand times greater than the most considerable of the rivers of stone vomited from its bosom, is, in fact, from its summit to its base, down even to the lowest submarine depths, nothing but the product of successive eruptions throwing out the molten

matter of the interior. The volcano itself has slowly raised the walls of its crater, and then extended its long slopes down to the waters of the Ionian Sea. By its fresh beds of lava and scorix incessantly renewed one upon the other, it has ultimately reared its summit into the regions of snow, and has become, as Pindar called it, the great "pillar of heaven."

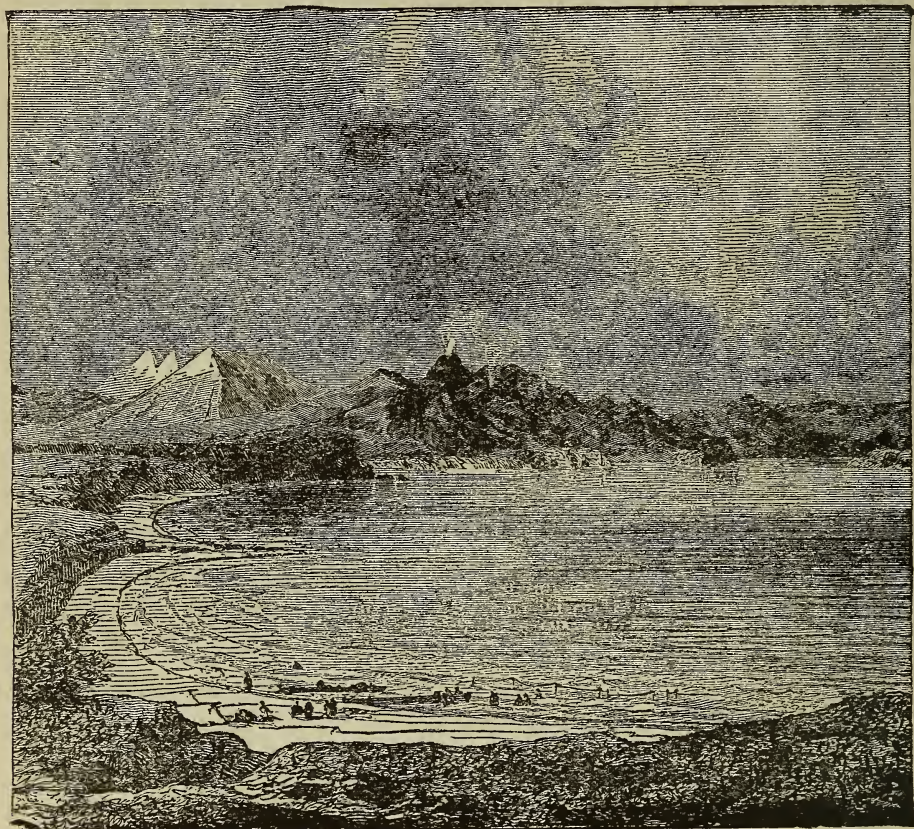
The earth being generally looked upon as immobility itself, it is a very strange thing to see it open to shoot out into the air torrents of gas, and shedding forth like a river the molten rocks of its interior. From what invisible source do all these fluid matters proceed which spread out in sheets over vast regions? Whence come those enormous bodies of steam, extensive enough to gather immediately in clouds around the loftiest summits, and sometimes indeed to fall in actual rain-showers? Science, as we have already said, has not completely answered these questions, the positive solution of which would be so highly important for our knowledge of the globe on which we live.

AN OLD POPULAR SUPERSTITION.

According to an ancient popular belief, Etna merely vomits forth, in the shape of vapor, the water which the sea has poured into the gulf of Charybdis. This legend, although clothed in a poetic garb, has in fact become the hypothesis which is thought beyond dispute by those savants who look upon volcanic eruptions as being a series of phenomena caused chiefly by water converted into steam.

The remarkable fact that all volcanoes are arranged in a kind of line along the coasts of the sea, or of inland lacustrine basins, is one of the great points which testify in favor of this opinion as to the infiltration of water, and give to it a high degree of probability. The Pacific, which is the principal reservoir of the water of our earth, is circled round by a series of volcanic mountains, some ranged in chains, and others very distant from one another, but still maintaining an evident mutual connection, constituting a "circle of fire," the total development of which is about 22,000 miles in length.

This ring of volcanoes does not exactly coincide with the semicircle formed by the coasts of Australia, the Sunda Islands, the Asiatic continent, and the western coasts of the New World. Like a crater described within some ancient and more extensive outlet of eruption, the great circle of igneous mountains extends



PICTURESQUE VIEW OF LAKE TAUPO AND VOLCANIC MOUNTAINS.

its immense curve in a westward direction across the waves of the Pacific, from New Zealand to the peninsula of Alaska; on the east, it is based on the coast of America, rising in the south so as to form some of the loftiest summits of the Andes.

The still smoking volcanoes of New Zealand, Tongariro and the cone of Whakari, on White Island, are, in the midst of the southern waters of the Pacific properly so called, the first evidence

of volcanic activity. On the north, a considerable space extends in which no volcanoes have yet been observed. The group of the Feejee Islands, at which the volcanic ring recommences, presents a large number of former craters which still manifest the internal action of the lava by the abundance of thermal springs. At this point, a branch crossing the South Sea in an oblique direction from the basaltic islands of Juan Fernandez as far as the active volcanoes of the Friendly group, unites itself with the principal chain which passes round, in a northeast direction, the coast of Australia and New Guinea.

GREAT FOCUS OF LAVA STREAMS.

The volcanoes of Abrim and Tanna, in the New Hebrides, Tinahoro, in the archipelago of Santa Cruz, and Semoya, in the Salomon Isles, succeeding one after the other, connect the knot of the Feejees to the region of the Sunda Islands, where the earth is so often agitated by violent shocks. This region may be considered as the great focus of the lava streams of our planet. On the kind of broken isthmus which connects Australia with the Indo-Chinese peninsula, and separates the Pacific Ocean from the great Indian seas, one hundred and nine volcanoes are vomiting out lava, ashes, or mud in full activity, destroying from time to time the towns and the villages which lie upon their slopes; sometimes, in their more terrible explosions, they ultimately explode bodily, covering with the dust of their fragments areas of several thousands of miles in extent.

From Papua to Sumatra, every large island, including probably the almost unknown tracts of Borneo, is pierced with one or more volcanic outlets. There are Timor, Flores, Sumbawa, Lombok, Bali, and Java, which last has no less than forty-five volcanoes, twenty-eight of which are in a state of activity, and, lastly, the beautiful island of Sumatra. Then, to the east of Borneo—Ceram, Amboyna, Gilolo, the volcano of Ternata, sung by Camoens, Celebes, Mindanao, Mindoro, and Luzon; these form across the sea, as it were, two great tracks of fire.

Northward of Luzon, the volcanic ring curves gradually so as
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to follow a direction parallel to the coast of Asia. Formosa, the Liou-Kieou archipelago, and other groups of islands stand in a line over the submarine volcanic fissure; farther on, there are the numerous volcanoes of Japan, one of which, Fusi-yama, with a cone of admirable regularity, is looked upon by the inhabitants of Nippon as a sacred mountain, from which the gods come down. The elongated archipelago of the Kuriles, comprising about a dozen volcanic orifices, unites Japan to the peninsula of Kamtschatka, in which no less than fourteen volcanoes are reckoned as being in full activity.

To the east of this peninsula, the range of craters suddenly changes its direction, and describes a graceful semicircle across the Pacific, from Behring Island to the point of Alaska. Thirty-four smoking cones stand on this great transversal dike, extending from continent to continent. Ounimak, which rises on the extremity of the peninsula of Alaska, the peak of which is 7939 feet in height, serves as the western limit of the New World, and is also pierced by a crater in a state of full activity.

VOLCANO IN ALASKA.

Eastward of the peninsula, the volcanic chain extends along the seacoast of the continent. Mount St. Elias, one of the highest summits in America, often vomits lava from its crater, which opens at an elevation of 17,716 feet. Farther to the south, another active volcano, Mount Fairweather, rises to a height of 14,370 feet. Next comes Mount Edgecumbe, in Lazarus Island, and the volcanic region of British Columbia. The whole chain of the Cascades, in Oregon, as well as the parallel ranges of the Sierra Nevada and the Rocky Mountains, are overlooked by a great number of volcanoes; but only a few of them continue to throw out smoke and ashes: these are Mount Baker, Renier, and St. Helens, enormous peaks 10,000 to 16,000 feet high.

In California and Northern Mexico, it is probable that the basaltic and trachytic mountains on the coast no longer present outlets of eruption. Subterranean activity is not manifested with any degree of violence until we reach the high plateaux of Central

Mexico. There a series of volcanoes, rising over a fissure crossing the continent, extends over the whole plateau of Anahuac, from the Southern Ocean to the Gulf of Mexico. The Colima, then the celebrated Jorullo, which made its appearance in 1759, the Nevado de Tolima, Istacihuetl, Popocatepetl, Orizaba, and Tuxtla are the vents for the furnace of lava which is boiling beneath the Mexican plateau.

To the south, in Gautemala and the South American republics, thirty burning mountains, much more active and terrible than those of Anahuac, rise in two chains, one of which is parallel to the sea-coast, and the other crosses obliquely the isthmus of Nicaragua. Among these numerous volcanoes there are some, the names of which have become famous on account of the frightful disasters which have been caused by their eruptions. Such are the mountains del Fuego and del Agua, above the Ciudad-Antigua of Gautemala; the Phare d'Isalco, which during the night lights up far and wide the plains of Salvador with its jets of molten stone and its column of red smoke; Coseguina, the last great eruption of which was probably the most formidable of modern times; the Viejo, Nuevo, Momotombo, and other mountains, which are almost worshiped from being so much dreaded.

ON THE PACIFIC COAST.

The depressions of the isthmuses of Panama and Darien interrupt the series of volcanoes which border on the coast of the Pacific. The peak of Tolima, which rises to the great height of 17,716 feet, is the most northern of the active volcanoes of South America, and is also one of the most distant from the sea among all the fire-vomiting mountains, for the distance from its base to the Pacific coast is not less than 124 miles. South of Tolima, and the great plateau of Pasto, where there likewise exists a crater, stands the magnificent group of sixteen volcanoes, some already extinct and some still smoking, over which towers the proud dome of Chimborazo.

Occupying an elliptical space, the great axis of which is only about 112 miles long, this group, comprising the Tunguagua,

Carahuizo, Cotopaxi, Antisana, Pichincha, Imbabura, and Sangay, is often looked upon as but one volcano with several eruptions; it is the cluster which, on the southern coasts of the Isthmus of Panama, corresponds symmetrically to the volcanic group of Anahuac. South of Sangay, which is perhaps the most destructive volcano on the earth, the chain of the Cordelleras offers no volcanoes for a length of about 930 miles; but in Southern Peru the volcanic series recommences, and outlets of eruption still in action open at intervals among extinct volcanoes and domes of trachyte.

The three smoking peaks of the inhabited part of Chili, the mountains of Antuco, Villarica, and Osono, terminate the series of the great American volcanoes; the activity of subterranean action is, however, disclosed by some other less elevated craters down to the extremity of the continent as far as the point of Terra-del-Fuego. This is not all; the South Shetland Islands, situated in the Southern Ocean, in a line with the New World, are likewise volcanic in their character; and if the same direction be followed toward the polar regions, the line will ultimately touch upon the coasts of the land of Victoria, on which rise the two lofty volcanoes of Erebus and Mount Terror, discovered by Sir John Ross.

VOLCANIC CIRCLE ROUND THE EARTH.

Stretching round the sphere of the earth, the great volcanic circle is extended toward the north by various islets of the antarctic, and ultimately rejoins the archipelago of New Zealand. Thus is completed the great ring of fire which circles round the whole surface of the Pacific Ocean.

Within this ampitheatre of volcanoes a multitude of those charming isles, which are scattered in pleiads over the ocean, are also of volcanic origin, and many of them can be distinguished from afar by their smoking or flaming craters. Of this kind are some of the Marianne and Gallapagos Islands, which contain several orifices in full activity, and more than two thousand cones in a state of repose. Among these we must especially mention the Sandwich Islands, the lofty volcanoes of which rise in the

middle central basin of the North Pacific like so many cones of eruption in the midst of a former crater changed into a lake.

The Mauna-Loa and Mauna-Kea, the two volcanic summits of the island of Hawaii, are each more than 13,000 feet in height ; and the eruptions of the first cone, which are still in full activity, must be reckoned among the most magnificent spectacles of this kind. On the sides of the Mauna-Loa opens the boiling crater of



VOLCANO OF TONGARRIRI, NEW ZEALAND.

Kilauea, which is, without doubt, the most remarkable lava-source which exists on our planet.

Round the circumference of the Indian Ocean the border of volcanoes is much less distinct than round the Pacific ; still it is possible to recognize some of its elements. To the north of Java and Sumatra, the volcanoes of which overlook the eastern portion of the basins of the Indian seas, stretches the volcanic archipelago of the Andaman and Nicobar Islands, in which there are several cones of eruption in full activity. On the west of Hindostan, the

peninsula of Kutch, and the delta of the Indus, are often agitated by subterranean forces.

Many mountains on the Arabian coast are nothing but masses of lava; and, if various travelers are to be believed, the volcanic furnace of these countries is not yet extinct. The Kenia, the great mountain of Eastern Africa, has on its own summit a crater still in action—perhaps the only one which exists on this continent. Lastly, a large number of islands which surround the Indian Ocean on the west and on the south—Socotora, Mauritius, Reunion, St. Paul, and Amsterdam Islands—are nothing but cones of eruption, which have gradually emerged from the bed of the ocean.

The volcanic districts which are scattered on the edge of the Atlantic are likewise distributed with a kind of symmetry round three sides of this great basin. On the north, Jan Mayen, so often wrapt in mist, and the more considerable island of Iceland, pierced by numerous craters, Hecla, the Skapta-Jokul, the Kotlugaja, and seventeen other mountains of eruption, separate the Atlantic from the Polar Ocean. At about 1500 miles nearer the equator the peaks of the Azores, some extinct and some still burning, rise out of the sea.

DEAD VOLCANOES.

The archipelago of the Canaries, over which towers the lofty mass of the peak of Teyda, continues toward the south the volcanic line of the Azores, and is itself prolonged by the smoking summits of the Cape de Verde Islands. All the other mountains of lava which spring up from the bed of the Atlantic more to the south appear to have completely lost their activity, and on the coast itself there is, according to Burton, only one volcano still in action—that of the Cameroons. With regard to the “line of fire” along the western Atlantic, it is developed at the entrance of the Caribbean Sea with perfect regularity, like the range of the Aleutian Isles. Trinidad, Grenada, St. Vincent, St. Lucia, Dominica, Gaudeloupe, Montserrat, Nevis, St. Kitts, and St. Eustatius are so many outlets of volcanic force, either through their

smoking craters or their mud volcanoes, their solfataras or their thermal springs.

North and south of the Antilles, the eastern coast of America does not present a single vent of eruption. It is a remarkable fact that the two volcanic groups of the Antilles and the Sunda Islands are situated exactly at the antipodes one of the other, and also in the vicinity of the two poles of flattening, the existence of which on the surface of the globe has been proved by the recent calculations of astronomers. More than this, these two great volcanic centres, which are undoubtedly the most active on the whole earth, flank, one on the west and the other on the east, the immense curve of volcanoes which spreads round the Pacific.

HIGH SUMMITS ON FIRE.

The Mediterranean is not surrounded by a circle of volcanoes ; but there, as elsewhere, it is from the midst of the sea, or immediately on the sea-coast, that the burning mountains rise—Etna, Vesuvius, Stromboli, Volcano, Epomeo and Santorin. In like manner, the volcanoes of mud and gas of the peninsula of Apcheron, and the summit of Demavend, 14,436 feet high, rise at no great distance from the Caspian Sea.

With regard to the volcanoes of Mongolia—the Turfan, which is said to be still in action, and the Pe-chan, which, according to Chinese authors, vomited forth, up to the seventh century, “fire, smoke, and molten stone, which hardened as it cooled”—their existence is not yet absolutely proved ; but even if these mountains, situated in the centre of the continent, should be in full activity, their phenomena might depend on the vicinity of extensive sheets of water, for this very region of Asia still possesses a large number of lakes, the remnants of a former inland sea, almost as vast as the Mediterranean.

What is the number of volcanoes which are still vomiting forth lava during the present period of the earth’s vitality ? It is difficult to ascertain, for often mountains have seemed for a long time to be extinct ; forests have grown up in their disused craters, and their beds of lava have been covered up under a rich carpet of

vegetation, when suddenly the sleeping force beneath is aroused and some fresh volcanic outlet is opened through the ground.

When Vesuvius woke up from its protracted slumber to swallow up Pompeii and the other towns lying round its base, it had rested for some centuries, and the Romans looked upon it as nothing but a lifeless mountain like the peaks of the Apennines. On the other hand, it is very possible that some craters, from which steam and jets of gas are still escaping, or which have thrown out lava during the historic era, have entered decisively into a period of repose, ceasing somehow to maintain their communication with the subterranean centre of molten matter. The number of vents which serve for the eruption of lava can, therefore, be ascertained in a merely approximate way.

Humboldt enumerates 223 active volcanoes; Keith Johnston arrives at the larger number of 270, 190 of which are comprehended in the islands and the Pacific "circle of fire;" but this latter estimate is probably too small. To the number of these burning mountains, standing nearly all of them on the sea-shore, or in the vicinity of some great fresh water basin, must be added the salses, or mud-volcanoes, which are also found near large sheets of salt water. With regard to the thousands of extinct volcanoes which rise in various parts of the interior of the continent, geology shows that the sea used formerly to extend round their bases.

CHAPTER XX

TORRENTS OF STEAM ESCAPING FROM CRATERS.—GASES PRODUCED BY THE DECOMPOSITION OF SEA-WATER.—HYPOTHESES AS TO THE ORIGIN OF ERUPTION.—GROWTH OF VOLCANOES.

ONE of the most decisive arguments which can be used in favor of a free communication existing between marine basins and volcanic centres is drawn from the large quantities of steam which escape from craters during an eruption, and compose, according to M. Ch. Sainte-Claire Deville, at least 999 thousandths of the supposed volcanic smoke. During the eruption of Etna, in 1865, M. Fouqué attempted to gauge approximately the volume of water which made its escape in a gaseous form from the craters of eruption.

By taking as his scale of comparison the cone which appeared to him to emit an average quantity of steam, he found this mass, reduced to a liquid state, would be equivalent to about 79 cubic yards of water for each general explosion. Now, as these explosions took place on the average every four minutes during a hundred days, he arrived at the result, that the discharge of water during the continuance of the phenomenon might be estimated at 2,829,600 cubic yards of water—a flow equal to that of a permanent stream discharging fifty-five gallons a second. Added to this, account ought to have been taken of the enormous convolutions of vapor which were constantly issuing from the great terminal crater at Etna, and, bending over under the pressure of the wind, spread out in an immense arch around the vault of the sky.

In great volcanic eruptions it often happens that these clouds of steam, becoming suddenly condensed in the higher layers of the atmosphere, fall in heavy showers of rain, and form temporary torrents on the mountain-side. According to the statements of Sir James Ross, the mountain Erebus, of the antarctic land, is

covered with snow, which it has just vomited forth in the form of vapor. It has besides been remarked that the vapor which issues from volcanoes is not always warm; often, according to Pœppig, it is of the same temperature as the surrounding air.

As was said long since by Krug von Nidda, a German savant, volcanoes must be looked upon as enormous intermittent springs. The basaltic flows may be compared to streams on account of the water which they contain. It is probable that most of the lava which flows from volcanic fissures owes its mobility to the innumerable particles of vapor which fill up all the interstices of moving mass. Being composed in great measure of crystals already formed in the body of which may be noticed nodules and crystals rounded by friction, the lava would be unable to descend over the slopes if it were not rendered fluid by its mixture with steam; and the gradual slacking in speed and ultimate stoppage of the flow are chiefly caused by the setting free of the gases which served as a vehicle to the solid matter. Owing to this rapid loss of their humidity, basalts contain in their pores but a very slight quantity of water in comparison with other rocks. Yet even old lava themselves contain as much as ten to nineteen thousandths of water at the edge of the bed, and five to eighteen thousandths at the centre.

SEA-WATER DECOMPOSED.

The various substances which are produced from craters also tend to show that sea-water has been decomposed in the great laboratory of lava. Ordinary salt or chloride of sodium, which is the mineral that is most abundant in sea-water, is also that which is deposited the first and most plentifully round the orifices of eruption. Sometimes, the scorïæ and ashes are covered for a vast space with a white efflorescence, which is nothing but common salt; one might fancy it a shingly beach which had just been left by the ebbing tide. After each eruption of Hecla, the Icelanders are in the habit, it is said, of collecting salt on the slopes. The lava from the eruption of Frumento, analyzed by M. Fouqué, contained about thirteen ten thousandths of marine salt.

Almost all other component parts of sea-water are likewise found in the gases and deposits of fumerolles ; only the salts of magnesia have disappeared, but still are found under another form among the volcanic products. Being decomposed by the high temperature, just as they would be in the laboratory of a chemist, they go to constitute other bodies. Thus the chloride of magnesium is changed into hydrochloric acid and magnesia ; the gas escapes in abundance from the fumerolles, while the magnesia remains fixed in the lava.

FOUR PERIODS IN EVERY ERUPTION.

As M. Ch. Sainte-Claire Deville was the first to ascertain with certainty, four successive periods may be observed in every eruption, each of which periods assumes a different character, owing to the exhalation of certain substances. After the first period, remarkable especially for marine salt and the various compounds of soda and potash, comes a second in which the temperature is lower, and during which brilliantly colored deposits of chloride of iron are formed and hydrochloric and sulphurous acids are expelled. When the temperature is below 392° (Fahr.), there are ammoniacal salts and needles of sulphur, which are found in yellowish masses on the scoriæ of lava.

Lastly, when the heat of the erupted bodies is below 212° (Fahr.), the fumerolles eject nothing but steam, azote, carbonic acid and combustible gases. Thus the activity of the exhalations and deposits is in proportion to the incandescence of the lava. At the commencement of the eruption, the orifices throw out a large quantity of substances, from marine salt to carbonic acid ; but by degrees the power of elaboration weakens simultaneously with the heat, and the gases ejected gradually diminish in number, and testify, by their increasing rarity, to the approaching cessation of volcanic phenomena. In consequence of the difference which is presented by the exhalations during the various phases of eruptions of lava, observers have, at first sight, thought that each volcano was distinguished by emanations peculiar to itself. Hydrochloric acid was looked upon as one of the normal

products of Vesuvius, and sulphurous vapors as more especial to Etna. It was stated (with Boussingault) that carbonic acid was exhaled especially by the volcanoes of the Andes; and, with Bunsen, it was believed that combustible gases prevailed in the eruptions of Hecla.

In his beautiful investigations into the various chemical phenomena presented by Etna and the neighboring volcanic outlets, such as Vesuvius and Stromboli, M. Fouqué appears to have established as a fact which must be henceforth beyond dispute, that the gradual series of these emanations is just that which would be produced by the decomposition of sea-water. Added to this, we also find in lava iodine and fluorine, both of which we should expect to detect in it on account of their presence in sea-water. The salts of bromine, of which, however, only a slight trace is found in sea-water, have not yet been detected in volcanic products, which, no doubt, proceeds from the difficulty which chemists have experienced in separating such very small quantities.

MELTED ROCKS.

The other matters ejected by eruptions are of terrestrial origin, and evidently proceed from rocks reduced by heat to a liquid or pasty state; they consist principally of silica and alumina, and contain, besides, lime, magnesia, potash, and soda. Oxides of iron also enter into the composition of lava, to the extent of more than one-tenth, which is a very considerable proportion, and warrants us in looking upon the volcanic flows as actual torrents of iron ore; sometimes, indeed, this metal appears in a pure state. It is to this presence of iron that lava especially owes its reddish color, and the sides of the crater their diversely colored sides.

Compounds of copper, maganese, cobalt, and lead are also met with in lava; but, in comparison with the iron, they are but of slight importance. Lastly, phosphates, ammonia, and gases composed of hydrogen and carbon are discharged during eruptions. The presence of these bodies is explained by the enormous proportion of animal and vegetable matter which is decomposed in

sea-water. Ehrenberg found the remains of marine animalculæ in the substances thrown out by volcanoes.

Is the composition of the lava, and especially that of the vapor and gases, the same in those eruptions which take place at a great distance from the ocean? It is probable that, as regards this point, considerable differences might be established between the products of volcanoes placed on the sea-coast, such as Vesuvius and Etna, and those which rise far in the interior of the land, as Tolima, Jorullo, and Puracé. This comparative study, however, which would be calculated to throw light on the chemical phenomena of deep-lying beds, has as yet been made at only a few points.

HOT WATER UNDER GROUND.

Eruptions are rare in volcanoes situated far from the coast, and when they do take place, scientific men do not happen to be on the spot to study the course of the occurrence. Popocatepetl, one of the most remarkable continental volcanoes, produces a large quantity of hydrochloric acid; the snow from it, which has a very decided muriatic taste, is carried by the rain into the Lake of Tezcuco, where, in conjunction with soda, it forms salt.

When the water, either of sea or rivers, penetrates into the crevices of the terrestrial envelope, it gradually increases in temperature the same as the rocks it passes through. It is well known that this increase of heat may be estimated on the average at least as regards the external part of the planet, at 1° (Fahr.) for every 54 feet in depth. Following this law, water descending to a point 7500 feet below the surface would show, in the southern latitudes of Europe, a temperature of about 212° (Fahr.). But it would not on this account be converted into steam, but would remain in a liquid state, owing to the enormous pressure which it has to undergo from the upper layers.

According to calculations, which are based, it is true, on various hypothetical data, it would be at a point more than nine miles below the surface of the ground that the expansive force of the water would attain sufficient energy to balance the weight of the superincumbent liquid masses, and to be suddenly converted

into steam at a temperature of 800° to 900° (Fahr.). These gaseous masses would then have force to lift a column of water of the weight of 1500 atmospheres; if, however, from any cause, they can not escape as quickly as they are formed, they exercise their pressure in every direction, and ultimately find their way from fissure to fissure until they reach the fused rocks which exist in the depths. To this incessantly increasing pressure we must, therefore, attribute the ascent of the lava into vent-holes of volcanoes, the occurrence of earthquakes, the fusion and the rupture of the terrestrial crust, and, finally, the violent eruptions of the imprisoned fluids.

But why should the vapor thus pervade the subterranean strata and upheave them into volcanic cones, when, by the natural effect of its overcoming the columns of water which press it down, it ought simply to rise toward the bed of the sea from which it descended? In the present state of science, this is a question to which it seems absolutely impossible to give a satisfactory answer, and geologists must at least have the merit of candidly acknowledging their ignorance on this point.

STEAM IN VOLCANIC ERUPTIONS.

The discoveries of natural philosophy and chemistry, which have been the means of making known to us the enormous activity of steam in volcanic eruptions, will doubtless, sooner or later, explain to us in what way this activity is exercised in the subterranean cavities. But at the present time the phenomena which are taking place in the interior of our globe are not better known to us than the history of the lunar volcanoes.

Be this as it may, the direct observations which have been made on volcanic eruptions have now rendered it a very doubtful point whether the lavas of various volcanoes proceed from one and the same reservoir of molten matter, or from the supposed great central furnace which is said to fill the whole of the interior of the planet. Volcanoes which are very close to one another show no coincidence in the times of their eruptions, and vomit forth at different epochs, lavas which are most dissimilar both in

appearance and mineralogical composition. These facts would be eminently impossible, if the craters were fed from the same source.

Etna, the group of the Lipari Isles, and Vesuvius, have often been quoted as being volcanic outlets placed upon the same fracture of the terrestrial crust; and it is added, in corroboration of this assertion, that a line traced from the Sicilian volcano to that of Naples passes through the ever-active furnace of the Lipari Isles. Although the mountain of Stromboli, so regular in its eruptions, is situated on a line slightly divergent from the principal line, and, on the other side, the volcanic isles of Salini, Alicudi, and Felicudi tend from east to west, it is possible, and even probable, that Vesuvius and Etna are in fact situated on fissures of the earth which were once in mutual communication. But during the thousands of years in which these great craters have been at work, no connection between the r eruptions has ever been positively certified.

TWO INDEPENDENT VOLCANOES.

Sometimes, as in 1865, Vesuvius vomits forth lava at the same time as Etna; sometimes it is in a state of repose when its mighty neighbor is in full eruption, and rouses up when the lava of Etna has cooled. There is nothing which affords the slightest indication of any law of rhythm or periodicity in the eruptive phenomena of the two volcanoes. The inhabitants of Stromboli state that, during the winter of 1865, at the moment when the sides of Etna were rent, the volcanic impulse manifested itself very strongly in their island by stirring up the always agitated waves of the lava-crater which commands their vineyards and houses.

A comparative calm, however, soon succeeded this temporary effervescence, and in the adjacent island of Volcano no increase of activity was noticed. If the shafts of Etna, Vesuvius, and the intervening volcanoes, take their rise in one and the same ocean of liquid lava, all the lower craters must necessarily overflow simultaneously with the most elevated. Now, as has often been

noticed, the lava may ascend to the summit of Etna, at a height of 10,827 feet, without a simultaneous flow of rivers of molten stone from Vesuvius, Stromboli, and Volcano, which are respectively but one-third, one-fourth, and one-tenth the height of the former. In like manner, Kilauea, situated on the sides of Mauna-Loa, in the Isle of Hawaii, in no way participates in the eruptions of the central crater opening at a point 9800 feet higher up, and not more than twelve miles away.

If there is any present geological connection between the volcanoes of one and the same region, it probably must be attributed to the fact of their phenomenal depending on the same climatic causes, and not because their bases penetrate to one and the same ocean of fire. Volcanic orifices are not, therefore, "safety valves," for two centers of activity may exist on one mountain without their eruptions exhibiting the least appearance of connection.

OPINIONS OF MEN OF SCIENCE.

Isolated as they are amid all the other formations on the surface of the earth, lavas appear as if almost independent of the rest. Basalts, trachytes, and volcanic ashes, are the comparatively modern products which are scarcely met with in the periods anterior to the Tertiary age. Only a very small quantity of these lavas of eruption has been found in the Secondary and Palæozoic rocks. Formerly, most geologists thought that the granites and rocks similar to them had issued from the earth in a pasty or liquid state; they looked upon them as the "lavas of the past," and believed that these first eruptive rocks were succeeded age after age by the diorites, the porphyries, the trap-rocks, then by the trachytes and the basalts of our own day, all drawn from a constantly increasing depth.

They thought also that, in the future, when the whole series of the present lavas shall have been thrown up to the surface, volcanoes would produce other substances as distinct from the lavas as the latter are from the granite. Granites, however, differ so much from the trachytes and basalts as to render it impossible for us to imagine that they have the same origin; added to which,

the labors of modern savants have proved that, under the action of fire, granite and the other rocky masses of the same kind, would have been unable to assume the crystalline texture which distinguishes them. We are, then, still ignorant how volcanic eruptions commenced upon the earth, and how they are connected with the other great phenomena which have co-operated in the formation of the external strata of the globe.

Considered singly, each volcano is nothing but a mere orifice, temporary or permanent, through which a furnace of lava is brought into communication with the surface of the globe. The matter thrown out accumulates outside the opening, and gradually forms a cone of debris more or less regular in its shape, which ultimately attains to considerable dimensions. One flow of molten matter follows another, and thus is gradually formed the skeleton of the mountain; the ashes and stones thrown out by the crater accumulate in long slopes; the volcano simultaneously grows wider and higher.

MOUNTS INTO CLOUDS AND SNOW.

After a long succession of eruptions, it at last mounts up into the clouds, and then into the region of permanent snow. At the first outbreak of the volcano the orifice is on the surface of the ground; it is then prolonged like an immense chimney through the center of the cone, and each new river of lava which flows from the summit increases the height of this conduit. Thus the highest outlet of Etna opens at an elevation of 10,892 feet above the level of the sea; Teneriffe rises to 12,139 feet; Mauna-Loa, in Hawaii, to 13,943 feet, and, more gigantic still, Sangay and Sahama, in the Cordilleras, attain to 18,372 and 23,950 feet in elevation.

This theory of the formation of volcanic mountains by the accumulation of lava and other matters cast out of the bosom of the earth presents itself quite naturally to one's mind. Most savants, from Saussure and Spallanzani down to Virlet, Constant Prévost, Poulett Scrope and Lyell, have been led, by their investigations, to adopt it entirely; indeed, in the present day it is

scarcely disputed. It is true that Humboldt, Leopold von Buch, and, following them, M. Elie de Beaumont, have put forth quite a different hypothesis, as to the origin of several volcanoes, such as Etna, Vesuvius and the Peak of Teneriffe.

According to their theory, volcanic mountains do not owe their present conformation to the long-continued accumulation of lava and ashes, but rather to the sudden upheaval of the terrestrial strata. During some revolution of the globe, the pent-up matter in the interior suddenly upheaves a portion of the crust of the planet into the form of a cone, and opens a funnel-shaped gulf between the dislocated strata, thus by one single paroxysm producing lofty mountains, as we now see them. As an important instance of a crater thus formed by the upheaval and rupture of the terrestrial strata, Leopold von Buch mentions the enormous abyss of the Isle of Palma, known by the natives under the name of "Caldron," or Caldera.

HUGE FUNNEL-SHAPED CAVITY.

The funnel-shaped cavity is of enormous dimensions, and is not less than four or five miles in width on the average; the bottom of it is situated about 2000 feet above the level of the sea. Lofty slopes, from 1000 to 2000 feet in height, rise round the vast amphitheatre, and abut upon inaccessible cliffs, the upper ledges of which reach a total altitude of 5900 to 6900 feet in height. The highest point, the Pico-de-los-Muchachos, is covered by snow during the winter months; and, although it penetrates to regions of the atmosphere which are of a very different character from those of the rest of the island, the slope that is turned toward the crater is so steep that blocks of stone falling from the summit roll down into the enclosed hollow.

The prodigious cavity in the Isle of Palma was, perhaps, the most striking instance that Leopold von Buch could bring forward in favor of his hypothesis; nevertheless, the exploration of this island, since carried out by Hartung, Lyell and other travelers, is very far from confirming the ideas of the illustrious German geologist. The lofty side walls of the hollow appear to be formed

principally, not of solid lava, which constitute scarcely a quarter of the whole mass, but of layers of ashes and scoriæ, regularly arranged like beds of sand on the incline of a talus. Basalts and strata of ashes lie upon one another in the greatest order round the inclosed hollow, which would be a fact impossible to comprehend if any sudden upheaval, acting in an upward direction with sufficient violence to break the terrestrial crust, had shattered and ruptured all the strata, and by a mighty explosion, opened out the immense Caldron of Palma.

LIKE CRACKS IN BROKEN GLASS.

Finally, if a phenomenon of this kind had taken place, star-formed cracks, like those produced in broken glass, would be visible across the thickness of the upheaved strata, and their greatest width would be turned toward the crater. Now there are no fissures of this kind, and the ravines in the circumference of the volcano, which one might perhaps be tempted to confound with actual ruptures of the ground, become wider in proportion as they approach the sea. The enormous cavity in Palma is, therefore, a crater similar to those of volcanoes of less dimensions. It is, however, certain that the Caldera was once both shallower and less in extent, for the ashes and volcanic scoriæ are easily carried away by the rain, which is swallowed up in the bottom of the basin, and has hollowed out for itself a wide drainage channel in a southwest direction.

M. Elie de Beaumont, as his chief support of Leopold von Buch's hypothesis, brought forward the fact that most of the strata of lava—a section of which may be seen on the sides of Etna, in the immense amphitheatre of the Val del Bove—are very sharply inclined. The celebrated geologist affirmed that thick sheets of molten matter could not run down steep slopes without being very soon reduced, in consequence of the acceleration of their speed, into thin layers of irregular scoriæ. If this were really the case, the position of the thick flows of lava in the Val del Bove must have changed since the date of the eruption. It would then be necessary to admit that they have been violently tilted up after having

been originally deposited on the soil in sheets, which were either horizontal or very gently sloped.

Nevertheless, the recent observations made by Sir C. Lyell, those of Darwin on the cones of the Gallapagos Isles, and of Dana on the lava flows of Kilauea; lastly, the remarks of the Italian savants who studied on the spot the volcanic phenomena of Vesuvius and Etna, have satisfactorily proved that, in modern times, a great number of rivers of lava, and especially that of the Val-de-Bove, in 1852 and 1853, have flowed over steep slopes varying in inclination from 15 to 40 degrees. It must, besides, be understood that the lava which poured over the steepest slopes was exactly that portion which, not having experienced any cause of delay, or met with any obstacle, in its course, presented layers of the most uniform consistence and the most regular action.

CLEFT IN THE EARTH.

One of the strongest arguments of scientific men in favor of the theory of upheaval is, that certain volcanic mountains, especially that of Monte-Nuovo, Pouzzoles, and Jorullo, in Mexico, had been suddenly raised up by the swellings of the soil. Now the unanimous testimony of those who, more than three centuries ago, witnessed the eruption of Monte-Nuovo, is, that the earth was cleft open, affording an outlet to vapor, ashes, scorïæ, and lava, and that the hill, very much lower than some of the subordinate cones of Etna, gradually rose during four days by the heaping up of the matter thrown out. The total volume of this eruption was no doubt considerable, but compared with the amount of matter which flowed down upon Catania in 1669, or with the rivers of lava from Skaptar-Jokul, it is a mass of no great importance.

Added to this, if the soil was really upheaved, how was it that the neighboring houses were not thrown down, and that the colonnade of the Temple of Neptune, which stands at the foot of the mountain, kept its upright position? With regard to Jorullo, which rises to a height of more than 1650 feet, the only witnesses of this volcano making its first appearance were the Indians, who fled away to the neighboring heights, distracted with terror.

We have, therefore, no authentic testimony on which we can base an hypothesis as to any swelling up of the ground in the form of a blister. Quite the contrary, the travelers who have visited this Mexican volcano since Humboldt have discovered beds of lava lying one over the other, as in all other cones of eruption ; and more than this, they have also ascertained that none of the strata in the ground overlooked by the mountain have been at all tilted up.

It is true enough that local swellings have often been observed in the burning matter issuing from the interior of the earth ; in many places the lava is pierced by deep caverns, and entire mountains—especially that of Volcano—have so many hollows in the rocks on their sides that every step of the climber resounds on them as if in a vault. Besides, the lava itself, being a kind of impure glass, is so pervaded by bubbles filled with volatile matter that, when acted upon by fire, so as to expel the water and the gas, it loses on an average, according to Fouqué, two thirds of its weight.

MIXTURE OF LAVA AND VAPOR.

But these caverns, these hollows and bubbles, proceed from the mixture of the lava with vapor which is liberated with difficulty from the viscous mass, or are caused by the longitudinal rupture of the strata during an eruption, and can in no way be compared to the immense blister-like elevation which would be formed by the strata of a whole district being tilted up to a height of hundreds, or even thousands, of yards, leaving at the summit, between two lines of fracture, room for an immense cavity.

None of these prodigious upheavels have been directly observed by geologists, and none of the legends invented by the fears of our ancestors, referring to the sudden appearance of volcanic mountains, which have been since confirmed. Lastly, the very structure of the peaks which are said to have risen abruptly from the midst of the plains testifies to the gradual accumulation of material that has issued from the bowels of the earth. It is, therefore, prudent to dismiss definitely an hypothesis which marks

an important period in the history of geology, but which, for the future, can only serve to retard the progress of science.

As, when the burning matter seeks an outlet, the earth is generally cleft open in a straight line, the volcanic orifices are frequently distributed somewhat regularly along a fissure, and the heaps of erupted matter follow one another like the peaks in a mountain chain. In other places, however, the volcanic cones rise without any apparent order on ground that is variously cleft, just as if a wide surface had been softened in every direction, and had thus allowed the molten matter to make its escape, sometimes at one point, sometimes at another. From the town of Naples—which is itself built on a half crater in great part obliterated—to the Isle of Nisida, which is an old volcano of regular form, the Phlegreæan Fields presents a remarkable example of this confusion of craters.

LANDSCAPE TURNED TO CHAOS.

Some are perfectly rounded, others are broken into, and their circle is invaded by the waters of the sea; grouped, for the most part, in irregular clumps, even encroaching upon one another and blending their walls, they give to the whole landscape a chaotic appearance. As Mr. Poulett Scrope very justly remarks, the aspect of the terrestrial surface at this spot reminds one exactly of the volcanic districts of the moon, dotted over, as it is, with craters.

As the type of a region pierced all over with volcanic orifices, we may also mention the Isthmus of Auckland, in New Zealand, which Dr. Hockstetter has reckoned, in an area of 230 square miles, sixty-one independent volcanoes, 520 to 650 feet in height on the average. Some are mere cones of tufa; others are heaps of scoriæ, or even eruptive hillocks, which have shed out round them long flows of lava. At one time the Maori chiefs used to intrench themselves in these craters as if in citadels; they escarped the outer slopes in terraces, and furnished them with palisades. At the present day, the English colonists, having become lords of the soil, have constructed their farms and country

houses on these ancient volcanoes, and are constantly bringing the soil under cultivation.

The Safa, in the Djebel-Hauran, is also a complete chaos of hillocks and abysses. On this plateau of 460 square miles, which the Arabs call a "portion of hell," almost all the craters open on the surface of the ground, and not on the summits of volcanoes scattered here and there on the black surface. In every direction there may be seen rounded cavities like the vacuities formed in scorïæ by bubbles of gas, only these cavities are 600 to 900 feet wide, and 65 to 160 deep. Some are isolated; some either touch or are separated by nothing but narrow walls like masses of red or darkish-colored glass. One hardly cares to venture on these narrow isthmuses, bordered by precipices, and intersected here and there by fissures.

ALWAYS SLOPING IN FORM.

The normal form of the volcanoes in which the work of eruption takes place is that of a slope of debris arranged in a circular form round the outlet. Whether the volcano be a mere cone of ashes or mud only a few yards high, or rise into the regions of the clouds, vomiting streams of lava over an extent of ten or twenty miles, it none the less adheres to the regular form so long as the eruptive action is maintained in the same channel, and the debris thrown out falls equally on the external slopes.

The beauty of the cone is increased by that of the crater. The terminal orifice from which the lava boils out well deserves, from the purity of its outline, its Greek name of "cup," and the harmony of its curve contrasts most gracefully with the declivity of the slope. In some volcanoes the symmetry of the architectural lines is so complete that the crater itself contains a cone placed exactly in the centre of the cavity, and pierced by a second crater in miniature, from which the vapor makes its escape.

Volcanoes in which the eruptive action frequently changes its position—and these are the more numerous class—do not possess this elegance of outline. Very often the upheaved lava finds some weak place in the walls of the crater; it hollows them out at first,

and then, bringing all its weight to bear on the rocks which oppose its passage, it ultimately completely breaks down the edge of the crater, leaving perhaps only one side standing. Among the European volcanoes, Vesuvius is the best example of these ruptured craters: before A. D. 79, the escarpments of La Somma, which now surround with their semicircular rampart the terminal cone of Vesuvius, were the real crater. The portion of it which no longer exists disappeared, and buried under its debris the towns of Herculaneum and Pompeii.

INCREASING DIMENSIONS.

Active volcanoes, however, never cease to increase in all their dimensions, and sooner or later the breach is ultimately repaired; the remains of the former craters are gradually hidden under the growing slopes of the central cone. Thus a former crater on Etna, which was situated at a point three miles in a straight line from the present outlet, at the commencement of the Val del Bove, has been gradually obliterated by the lava of successive eruptions; prolonged explorations on the part of MM. Seyell and Waltershausen have been necessary in order to find it out. The normal form of Etna is that of a cone of debris placed upon a large dome with long slopes, becoming more and more gentle, and descending gracefully toward the sea.

In fact, in most of the eruptions, the lava does not rise as far as the great crater, and breaks through the sides of the volcano so as to flow laterally over the flanks of Etna. These eruptions, succeeding one another in the course of centuries, bring about the necessary result of gradually enlarging the dome which constitutes the mass of the mountain, thus breaking the uniformity of the lateral talus. The same thing occurs with regard to Vesuvius on the side which faces the seacoast. There, the terminal cone stands on a kind of dome, which has been gradually formed by the coats of lava running one over the other. If Vesuvius continues to be the great volcanic outlet of Italy, and rises gradually into the sky by the superposition of lava and ashes, it cannot fail, some time or other, to assume a form similar to that of the Sicilian giant.

The volcanoes which present cones of almost perfect regularity are those which have their terminal outlet alone in a state of activity, and vomit out a large quantity of ashes or other matter which glides readily over the slopes. Among this class of mountains, those which attain any considerable elevation are distinguished by their majesty from all other peaks. Stromboli, although it is not more than 2600 feet in height, is one of the wonders of the Mediterranean. From its proud form, it will readily be understood that its roots plunge down into the sea to an enormous depth; the slope of debris may be seen, so to speak, prolonged under the water down to the abysses of 3000 to 4000 feet, which the sounding-line has reached at the bottom of the Æolian Sea.

At sight of it one feels as if suspended in the midst of the void, as if the ship was sailing in the air midway up the mountain. This feeling of admiration mingled with dread increases when this great pharos of the Mediterranean is approached during the night over the dark-waved sea. Then the sky above the summit seems all lighted up by the reflection of the lava, and a misty band of vapor may be dimly seen girdling round the body of the volcano. In the daytime the impression made is of a different character; but it is none the less deep, for the real grandeur of Stromboli consists not so much in the immensity of the mass as in the harmony of its proportions.

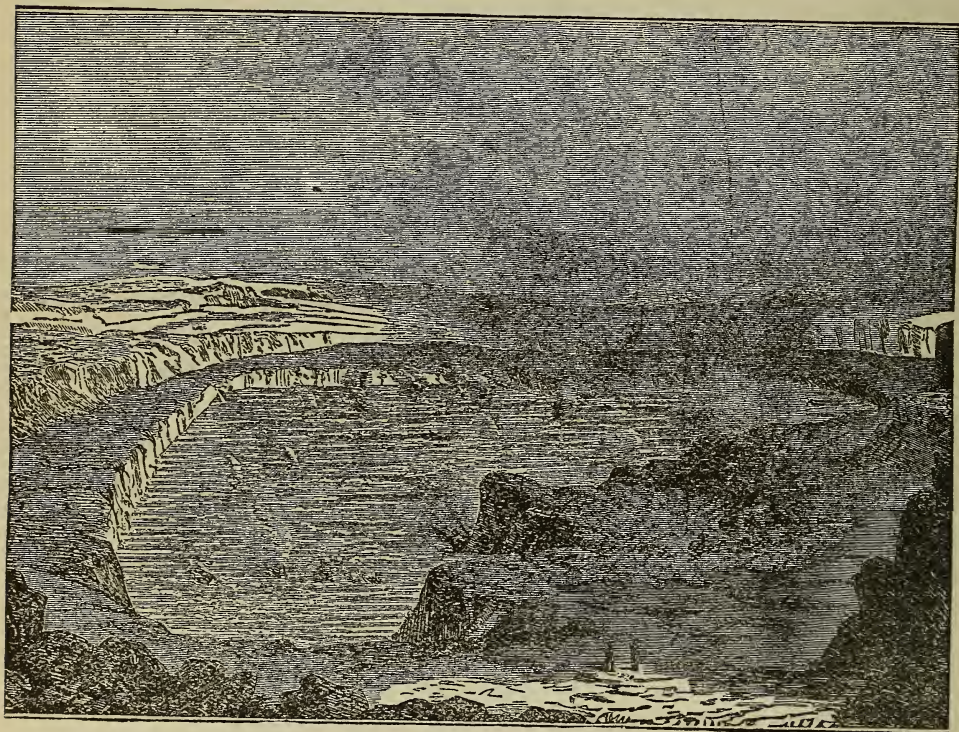
SACRED MOUNTAINS.

Volcanic mountains of an ideal form are those which infant nations have most adored. Among these sacred mountains are the sublime Cotopaxi of the Andes, Orizaba of Mexico, Mauna-Loa of Hawaii, and Fusi-Yama of Japan. The volcanoes of Java, and chiefly those in the eastern portion of the island, also present a very majestic appearance on account of their isolation.

Those on the western side are based upon an undulating plateau, which causes them to lose their appearance of height; but on the east all the volcanic mountains rise up from verdant plains like islands above the waves of the sea, and command the

horizon far and wide with their enormous cones. Between the Merapi and Lavoe mountains lies a depression, the highest ledge of which exceeds the level of the sea by only 312 feet. Between Lavoe and Villis the plain is 230 feet in height. Lastly, the plains which separate the Villis and Kelœet mountains nowhere attain an elevation of more than 200 feet above the ocean.

In the external details of their conformation many of the vol-



A REMARKABLE VOLCANO CRATER, ISLE OF JAVA.

canoes of Java present a regularity of outline which is all the more striking, since they owe it in great part to the monsoon rains, the most destructive agents of the tropical regions. In beating against the mountains, the clouds let fall their burden of moisture on the slopes composed of ashes and loose scorïæ. The latter offer but a slight resistance to the action of the temporary torrents which carry them away, and, crumbling down into the

plains which surround the base of the volcano, are deposited in long slopes, like those caused by avalanches.

In consequence of the fall of all this debris, the sides of the mountain are cut out at intervals by ravines or furrows, which gradually widen from the summit to the base of the mountains, and attain a depth of 200, 600, and 660 feet. There are some volcanoes, such as the Sumbing, in which these ravines assume so perfect a regularity that the whole mountain, with its equidistant furrows and its intermediate walls, resembles a gigantic edifice based upon enormous buttresses, like the nave of a Gothic cathedral.

BEAUTIFUL ISLAND.

Formerly the beauty of the island and the fury of its volcanoes were the cause of its being altogether dedicated to Siva, the god of destruction; and in the very craters of the burning mountains the worshippers of Terror and Death were in the habit of building their temples. In many spots the ruins of these sanctuaries are discovered in the midst of trees and thickets, which the Arab conquerors have left to grow in the formidable cavities of the volcanoes. Semerœ, the loftiest peak in the island, was the sacred mountain par excellence; the Sumbing, which rises in the centre of the island, was the "nail which fastens Java to the earth."

Even in our own time some faithful followers of Siva inhabit a sandy plain, more than four miles wide, which was once the crater of the Tengger volcano; every year they proceed solemnly to pour rice on the summit of an eruptive cone, into the roaring mouth of the monster. In like manner, in New Zealand, the ever-smoking orifice of Tongariro was considered as the only place worthy of receiving the dead bodies of their great chiefs: when cast into the crater, the heroes went to sleep among the gods.

But the volcanic divinities, like most of the other rulers invoked by nations, did not content themselves with the fruits of the earth or the companionship of a few warriors; they also demanded blood, both by their subterranean roarings, by their thundering eruptions, and their devastating rivers of lava. In-

numerable sacrifices have been offered to volcanoes to appease their anger: impelled by a mingled feeling of fear and ferocity, the priests of not a few religions have cast victims with great pomp into the gaping hollows of these immense furnaces.

Scarcely three centuries ago, when the disciples of Christianity were exterminated over the whole length and breadth of Japan, the followers of the new religion were thrown by hundreds into one of the craters of the Unsen, one of the most beautiful volcanoes of the archipelago; but this offering to the offended gods did not appease their anger, for, toward the end of the eighteenth century, this very same mountain and the neighboring summits caused by their eruptions one of the most frightful disasters of any that are mentioned in the history of volcanoes.

Actuated by a feeling of dread very similar to that exhibited by the Japanese priests, the Christian missionaries in America recognized in the burning mountains of the New World not the work of a god, but that of the devil, and went in procession to the edge of the craters to exorcise them. A legend tells how the monks of Nicaragua climbed the terrible volcano of Momotombo in order to quiet it by their conjurations; but they never returned; the monster swallowed them up.

CHAPTER XXI

VARIOUS KINDS OF LAVA.—BEAUTIFUL CAVE IN SCOTLAND.—
CREVICES IN VOLCANOES.—SNOW UNDER BURNING DUST.

LAVA is the most important product of the volcanic fires. The various kinds of lava differ very much in their external appearance, in the color of their substance, and in the variety of their crystals, but they are all composed of silicates of alumina or magnesia, combined with protoxide of iron, potash or soda, and lime. When the feldspathic minerals predominate, the rock is generally of a whitish, grayish or yellowish hue, and receives the name of trachyte. When the lava contains an abundance of crystals of augite, hornblende, or titaniferous iron, it is heavier, of a darker color, and often more compact; it then takes the generic formation of basalt. Numerous varieties, diversely designated by geologists, belong to this group.

Of all the lavas, trachyte is the least fluid in its form. In many places rocks of this nature have issued from the earth in a pasty state, and have accumulated above the orifice in the shape of a dome, "Just like a mass of melted wax." In this way were formed the great domes of Auvergne, the Puys de Dome and de Sarcouy. In this district the flows of trachytic lava are far inferior in length to the basaltic cheires; the most important do not exceed four or five miles in length.

At the present day, eruptions of trachyte are much more rare than those of other lavas; so much so, that certain authors class all the trachytic rocks among the formations of anterior ages. It is, however, ascertained that most of the American volcances and those of the Sunda Archipelago vomit out lava of this nature; the last eruptions of the Æolian Isles, Lipari and Volcano, likewise produced only trachyte and pumice-stone.

This latter substance resembles certain white, yellow, or greenish scoria, which issue like a frothy dross from the furnaces

of our iron-works, and is, like the compact trachyte, of a feldspathic nature. Some mountains are almost entirely composed of it; among others, the Monte Bianco of Lipari, which, viewed from a distance, appears as if covered with snow. Long white flows, like avalanches, fill up all its ravines, from the summit of the mountain to the shore of the Mediterranean; the slightest movement caused by the tread of an animal or a gust of wind detaches from the surface of the slope hundreds of stones, which bound down to the foot of the incline, and are borne away by the waves which bathe the base of the mountain.

In the southern part of the Tyrrhenean Sea, and especially in the vicinity of the Lipari (Æolian) Islands, the water is sometimes covered with these floating stones, almost like flakes of foam. In the Cordilleras the currents of fresh water convey the morsels of pumice to considerable distances. The River Amazon drifts down large quantities of pumice as far as its mouth, more than 3000 miles from the place where it fell into the river. Bates says that the Indians, who live too far away from the volcanoes even to know of their existence, assert that these stones, floating down the river by the side of their canoes, are surely solidified foam.

APPEARANCE OF VARIOUS LAVAS.

The external appearance of various lavas differs even more than their chemical composition. The more or less perfect state of fluidity, and the presence in them of a greater or less quantity of bubbles of vapor, give a very different texture to rocks which are composed of the same elements. Pumice-stone has the appearance of sponge; obsidian looks like black glass, and sometimes it is even semi-transparent.

It is entirely liquid, and issues from the interior of the earth like a stream flowing rapidly over the steeper slopes, and coagulating slowly in large sheets in the low ground and on the gentle inclines whither its own weight has drawn it. The surface of obsidian—for instance, that of Teneriffe—shines with a vitreous glitter; the cleavage of the rock is clean and sharp.

Some less degree of fluidity in the current of lava gives it

sometimes the appearance of resin; this is the stone which is called pechstein (pitch-stone). When the rock, issuing in a state of fusion from the bosom of the mountain, becomes still cooler, it contains innumerable perfectly-formed crystals, and only owes its fluidity to the particles of vapor in its pores. The external layer of the lava is also immediately covered with scoria which float in flakes on the fiery stream. These scoria, too, assume a great variety of shapes; some are mammillated, others are exceedingly rough and irregular.

In the Djebel-Hauran, near the crater of Abu-Ganim, there is an infinity of needles of red lava, about a yard high on the average, and bent in various directions toward the surface of the plateau; one might often fancy them flames half beaten down under the pressure of the wind. According to M. Wetzstein, these strange stone needles proceed from an eruption of flaky lava. In the Sandwich Islands, and in the Island of Réunion, certain crystals of a ferruginous appearance are grouped at the outlet of the crater in herbaceous forms of the most curious and sometimes elegant character.

RESEMBLE HEMP TOW.

Some of the products of the volcano of Mauna-Loa and Kilauea resemble the tow of hemp! These are the whitish filaments which are sometimes carried away by the wind; the Kanakes used to consider them as the hair of Pélé, the goddess of fire.

Among the old basaltic lavas there are some to which the name of "basalt" is more specially applied, which present a columnar disposition with wonderful regularity. These form the enormous monuments, much more imposing than those of man, which seem as if they had been constructed by giant builders, turning their mighty hands to the noble art of architecture, which is still practiced, though on a smaller scale, by us their feeble descendants. These magnificent colonnades of basalt are everywhere attributed to giants.

In Ireland, on the coast of Antrim, the summits of 40,000 prisms, leveled pretty regularly by the waves of the sea, and resembling a vast paved quay, have received the name of the

Giant's Causeway. In Scotland, the beautiful cave of the Isle of Staffa, hollowed out by the action of the waves between two ranges of basaltic shafts, is celebrated as the work of Fingal, the demigod. In the Sicilian Sea, the Faraglioni Isles, or Isles of the Cyclopes, situated not far from Catania, at the base of Etna, are looked upon by tradition as the rocks cast by Polyphemus on the ships of Ulysses and his companions. Many of these prisms are from 100 to 160 feet high, and are not less than from six to sixteen feet in thickness.

Near Fair Head and the Giant's Causeway some of the shafts connected with the perpendicular cliff of the headland are nearly 400 feet in height. In the Isle of Skye, some of the columns, according to M'Culloch's statement, are still higher. On the other hand, there are also colonnades in miniature, each shaft of which is not more than three quarters of an inch to an inch from the summit to the base ; instances of these are found in the basalts of the hill of Morven in Scotland.

BEDS OF LAVA ARRANGED IN COLUMNS.

Some geologists have thought that basaltic columns could not be formed except under the pressure of enormous masses of water ; but a comparative study of these rocks in different parts of the world has proved that several beds of lava are arranged in columns at heights considerably above the level of the sea. In this colonnade-like formation of lava there is, however, no phenomenon which is entirely peculiar to basalt. Trachyte, also, sometimes assumes this form, and M. Fouqué has discovered a magnificent instance of it in the island of Milo, in which there is a cliff composed of prismatic shafts 320 feet in height.

Masses of mud when dried in the sun, the alluvium of rivers, beds of clay or tufa, and, in general, all matter which, in consequence of the loss of its moisture, passes from a pasty to a solid state, either in a state of nature or in our manufactories and dwellings, likewise assume a columnar structure similar to that of the basaltic lava. In fact, the entire mass, when gradually losing the moisture which swelled out its substance, can not con-

tract so as to shift the position of all its particles toward the centre; certain points remain fixed, and round each of these the contraction of a portion of the mass takes place.

In basalt, in particular, it is the lower layer which assumes the columnar structure, for these alone cool gently enough to allow the phenomena of contraction to follow the normal course. The highest portion of the mass, being deprived, immediately after its issue from the earth, of the caloric and the steam which filled its pores, is almost immediately transformed into a more or less rough and cracked mass. But this very crust protects the rest of the lava against any radiation, and serves as a covering to the semi-crystalline columns which, by the continual contraction of their particles, are slowly separated from the rest of the mass.

A FOREST OF PRISMS.

When a section of a bed of basaltic lava has been laid bare by the water of a river, the waves of the ocean, or earthquake, the rough stones of the top layers may be seen lying, with or without any gradual transition, on a forest of prisms, sometimes rudimentary in their shape, but often no less regular in their shape than if they had been carved out by the hand of man. Most are of a hexagonal form; others, which were probably subject to less favorable conditions, have four, five or seven faces; but all are definitely separated from one another by their particles gathering round the central axis.

Mr. Poulett Scrope describes a fact which proves the enormous power of this contractile force. The colonnade of Burzet in Vivarais, contains numerous nodules of olivine, many of which are as large as a man's fist: and, in spite of their extreme hardness, have been divided into two pieces, each fixed in one of two adjacent columns. Although the two corresponding surfaces have been polished by the infiltration of water, it is impossible to doubt that the two separate portions were not once joined in the same nodule.

As natural philosophers have verified by experiments on various viscous substances, basaltic shafts are always formed per

pendicularly to the surface of refrigeration. Now, this surface being inclined, according to the locality, in a diversity of ways, the result is, that the columns may assume a great variety of directions in their position. Although most of them are vertical, on account of the cooling taking place in an upward direction, others, as at St. Helena, take a horizontal direction, and resemble trunks of trees heaped upon a wood-pile.

In other places, as at the Coupe d'Ayzac in Auvergne, the columns of a denuded cliff are arranged in the form of a fan, so as to lean regularly on the wall of the cliff as well as on the ground of the valley. At Samoskœ, in Hungary, a sheet of columnar basalt, very small at its origin, spreads out from the top of a rock like the water of a cascade, and hangs suspended over a precipice, resembling a cupola which has lost its base. Elsewhere masses of basaltic pillars radiate in every direction like the weapons in an immense trophy of arms.

LIKE GIGANTIC BAMBOOS.

An exact prismatic form, is not, however, the only shape assumed by the cooling lava. The phenomenon of contraction takes place in different ways, according to the nature of the erupted matter, the declivity of the slopes, and all the other surrounding circumstances. Thus, in consequence of the sinking of the rock, most basaltic prisms exhibit at intervals a kind of joint, which gives the columns a kind of resemblance to gigantic bamboos. In some lavas these joints are so numerous, and the edges of the stone are so eaten away by the weather, that the shafts are converted into piles of spheroids of a more or less regular form.

At the volcano of Bertrich, in the Eifel, one might fancy them a heap of cheeses; whence comes the name of "Cheese Cave," which is given to one of the caverns which opens in the flow of the lava. Sometimes, too, crystals scattered about in the midst of the mass have served as nuclei to globular concretions formed of numerous concentric layers. Lastly, many currents of molten matter present a tabular or schistose structure, caused, like that of slate, by the pressure of the superincumbent masses.

Although lava, when cooled, is easy enough to study, it is more difficult to observe with any exactitude the molten matter immediately on its exit from the craters or fissures; besides this, the opportunities for study which are afforded to savants are sometimes very dangerous. Long years often elapse before an enquirer can notice at his ease, and without fear of sudden explosions, the mouths of *Ætna* or *Vesuvius* filling up to the brink with boiling lava.

Stromboli is the only volcano in Europe in which this phenomenon occurs regularly at closely-recurring intervals, sometimes of only five minutes, or even more frequently. When an observer stands on the highest edge of the crater, he sees, about 300 feet below him, the waves of a matter which shines like molten iron, and tosses and boils up incessantly; sometimes it swells up like an enormous blister, which suddenly bursts, darting forth eddies of vapor accompanied by solid fragments.

HAS BOILED FOR CENTURIES.

For centuries past the lava has never ceased to boil in the cavity of *Stromboli*, and it is but very rarely that a period of even a few hours lapses without molten matter overflowing. Thus the crater, which, during the day, is white with steam, and during the night red with the glare of the lava, has served as a light-house for mariners ever since the first vessel ventured upon the *Tyrrhenian Sea*.

In *Nicaragua*, to the north of the Great Lake, the volcano of *Masaya* (or "Devil's Mouth") presents a spectacle similar to that of *Stromboli*, but grander, and perhaps still more regular. After having remained in a state of repose for nearly two centuries, from 1670 to 1853, the monster—which has received the name it bears from the frightful turbulence of its burning waves—resumed all its former activity. In this crater the enormous bubbles of lava, which ascend from the bottom of the abyss and throw out a shower of burning stones, break forth in a general way every quarter of an hour.

The volcano of *Isalco*, not far from *Sonsonate*, in the State of

San Salvador, is also one of the most curious on account of its regularity. Its first breaking out was noticed on the 29th of March, 1783, and since this date it has almost always continued to increase in size by throwing outside its cavity ashes and stones. Some of its eruptions, remarkable for their comparative violence, have been accompanied by flows of lava ; but, generally, the crater of Isalco confines itself to hurling burning matter to a height of 39 to 46 feet above its crater ; explosions follow one another at intervals of every two minutes. The total elevation of the cone of debris above the village of Isalco being 735 feet, and the slope of the side of the mass being, on the average, 35 degrees, M. von Seebach, one of the observers of the volcano, has been able to calculate approximately the bulk and regular increase of the mountain. In 1865 the mass of debris was about 35,000,000 of cubic yards, giving an increase of about 491,000 cubic yards every year, or 56 cubic yards every hour. The volcano, therefore, might be looked upon as a gigantic hour-glass.

WORLD-RENOWNED CRATER.

Of all the craters in the world, the one which most astonishes those who contemplate it is the crater of Kilauea, in the island of Hawaii. This volcanic outlet opens at more than 3900 feet of elevation on the sides of the great mountain of Mauna-Loa, which is itself crowned by a magnificent funnel-shaped crater 2735 yards across from one brink to the other. The elliptical crater of Kilauea is no less than three miles in length and seven miles in circumference. The hollow of this abyss is filled by a lake of lava, the level of which varies from year to year, sometimes rising and sometimes falling like water in a well.

In a general way, it lies about 600 to 900 feet below the outer edge, and, in order to study its details, it is necessary to get on to a ledge of black lava which extends round the whole circumference of the gulf ; this is the solidified edge of a former sheet of molten matter, similar to those circular benches of ice which, in northern countries, border the banks of a lake, and even in spring still mark the level the water has sunk from. The surface

of the sea of fire is generally covered by a thick crust over its whole extent; here and there the red lava-waves spring up like the water of a lake through the broken ice. Jets of vapor whistle and hiss as they escape, darting out showers of burning scoria, and forming cones of ashes on the crust 60 to 100 feet in height, which are so many volcanoes in miniature.

Intense heat radiates from the immense crater, and a kind of hot blast makes its way through all the chinks in the vertical walls of the sides. In the midst of the hot vapors, one feels as if lost in a vast furnace. During the night time an observer might fancy himself surrounded with flames; the atmosphere itself, colored by the red reflection of the vent holes of the volcano, seems to be all on fire.

RUSHES THROUGH THE OPENING.

The level or the fire lake of Kilauea is incessantly changing. In proportion as fresh lava issues forth from the subterranean furnace, the broken crust affords an outlet to other sheets of molten matter and fresh heaps of scoria, and gradually the boiling mass rises from ledge to ledge, and ultimately reaches the upper edge of the basin. Sooner or later, however, the level rapidly sinks. The fact is, that the burning mass contained in the depths of the abyss gradually melts the lower walls of solid lava; these walls ultimately give way at some weak points in their circumference, a crevice is produced in the outer face of the volcano, and the liquid matter, "drawn off" like wine from a vat, rushes through the opening made for it.

The flow increases the orifice by the action of its weight on the sill of the opening, and by melting the rocks which oppose its passage, and then, running down over the slopes, flows into the sea, forming promontories on the shore. In 1840 the crater was full to the brink, when a crack suddenly opened in the side of the mountain. This fissure extended to a distance of 131 feet from its starting-point, and vomited forth a stream of lava 37 miles long and 16 miles wide, which entirely altered the outline of the sea-coast, and destroyed all the fish in the adjacent waters. Mr.

Dana estimated the total mass of this enormous flow as equal to 7,200,000 cubic yards—that is, to a solid body fifty times as great as the quantity of earth dug out in cutting through the Isthmus of Suez.

The enormous basin of Kilauea, 1476 feet deep, remained entirely empty for some time, and the former lake of lava left no other trace of its existence than a solid ledge like those which had been formed at the time of previous eruptions. Since this date the great cauldron of lava has been several times filled and several times emptied, either altogether or in part.

OUTLET FOR OVERFLOW.

Almost all the volcanoes which rise to a great height, get rid, like Kilauea, of their overflow of lava through fissures which open in their side walls. In fact, the column of molten matter which the pressure of the gas beneath raises in the pipe of the crater is of an enormous weight, and every inch it ascends toward the mouth of the crater represents an expense of force which seems prodigious. The more or less hypothetical calculations which have been made as to the degree of pressure necessary for the steam to be able to act on the lava-furnace lead to the belief that the outlet-conduits of volcanoes, and consequently the mass of liquid stone to be lifted, are not less than nine miles in depth. Various geologists—among others Sartorius von Waltershausen, the great explorer of Etna—believe that the volcano-shafts are of a still more considerable depth. The rocks of the terrestrial surface, limestone, granite, quartz, or mica, are of a specific gravity two and a half times superior to that of water, while the planet itself, taken as a whole, weighs nearly five and a half times as much as the same mass of distilled water; the density of the interior layers must therefore increase from the circumference to the center. With regard to the proportion of this increase, it is established by a calculation, the whole responsibility of which must rest upon its authors. Baron Waltershausen has ascertained, by means of a great number of weighings, that the lava of Etna and that of Iceland have a specific gravity of 2.911.

The presumed consequence of this fact is that the rocks thrown out by the volcanoes of Sicily and Iceland proceed from a depth of seventy-seven to seventy-eight miles(?). Thus the shaft which opens at the bottom of the crater of Etna would be no less than seventy-seven miles deep, and the lava which boils in this abyss would be lifted by a force of 36,000 atmospheres, an idea altogether incomprehensible by our feeble imaginations. There would, then, be nothing astonishing in the fact that a mass of lava, which is sufficiently heavy to balance a pressure of this kind, should, in a great many eruptions, melt and break through the weaker parts of its walls, instead of ascending some hundreds or thousands of feet higher, so as to run out over the edge of the upper crater.

When the side of the mountain opens, and affords a passage to the lava, the fissure is always perceptibly vertical, and those which are continued to the summit pass through the very mouth of the volcano. In a general way, these fissures of eruption are of considerable length, and are sufficiently wide to form an impassable precipice. Before these fissures become obliterated by the lava or by other debris—such as the snow and earth of avalanches—they may be traced out by the eye as deep furrows hollowed out on the mountain side.

DEPRESSIONS FILLED WITH SNOW.

In 1669 the lateral fissure of *Ætna* extended over more than two-thirds of the southern side—from the plains of Nicolosi to the terminal gulf of the great crater. In like manner, in the Isle of Jan Mayen, the volcano of Beerenberg, 7514 feet high, presents from top to bottom a long depression filled up with snow, which is nothing else than a fissure of eruption. On other mountains, especially in Montserrat, Guadeloupe, and Martinique, these fissures have assumed such dimensions that the peaks themselves have been completely split in two.

Through outlets of this kind the lava jets out, first making its appearance at the upper part, where the declivity is generally steeper, then springing out below on the more gentle slopes of the lower regions of the mountain.

At the source itself the lava is altogether fluid, and flows with considerable speed—sometimes, on steep slopes, faster than a horse can gallop; but the course of the molten stone soon slackens, and the liquid, hitherto dazzling with its light, is covered by brown or red scoria, like those of iron just come out of a furnace. These scoria come together, and, combining, soon leave no interstices between them beyond narrow vent-holes, through which the molten matter escapes. The scoria then form a crust, which is incessantly breaking with a metallic noise, but gradually consolidates into a perfect tunnel round the river of fire; this is the *cheire*, thus named on account of the asperities which bristle on its surface.

STANDING ON A THIN SURFACE.

Any one may safely venture on the arch-shaped crust, although only a few inches above the mass in state of fusion, without any fear of being burnt, just as in winter we trust ourselves on the sheets of ice which cover a running stream. The pressure of the lava succeeds in breaking through its shell only at the lower parts of its flow, in spots where the waves of burning stone fall with all their weight. Then the envelope is suddenly ruptured and the mass springs out like water from a sluice, pushing before it the resounding scoria, and swelling out gently in the form of an enormous blister; it then again becomes covered with a solid crust, which is again broken through by a fresh effort of the lava.

Thus the river, surrounding itself with dikes, which it constantly breaks through, gradually descends over the slopes, terrible and inexorable, so long as the original stream does not cease to flow. The only means of diverting the current is to modify the incline in front of it, either by opposing obstacles to it to throw it to either side, or by preparing a road for it by digging deep trenches, or by opening up above some lateral outlet for the pent-up lava. In 1669, at the time of the great eruption which threatened to swallow up Catania, all these various means were adopted in order to save the town. On one side the inhabitants

worked at consolidating the rampart, and placed obstacles across the path of the current to turn it toward the south.

Other workmen, furnished with shovels and mattocks, ascended along the edge of the flow, and, in spite of the resistance offered by the peasants, tried to pierce through the shell of scoria, and thus, by tapping the stream, to open fresh outlets for the molten matter. These means of defense partly succeeded, and the terrible current which, at its source near Nicolosi, had been able to melt and pierce through the volcanic cone of Monpilieri at its thickest point (this cone standing in its path) was turned from its course toward the centre of Catania, and destroyed nothing but the suburbs.

The radiation from the lava being arrested by the crust of scoria, which is a very bad conductor of heat, the temperature of the air surrounding a flow of lava rises but very slightly. The Neapolitan guides have no fear in approaching the Vesuvian lava in order to stamp the rough medals made of it, which they sell to foreigners. At a distance of a few yards from the vent-holes in the cheire the trees of Etna continue to grow and blossom, and some clumps, indeed, may be seen flourishing on an islet of vegetable earth lying between two branches of a flow of burning lava. And yet, by a contrast which at first sight seems incomprehensible, it sometimes happens that trees which are distant from any visible flow of molten matter suddenly wither and die.

VINEYARDS BLIGHTED.

Thus, in 1852, at the time of the great eruption from the Val del Bove, on the eastern slopes of Mount Etna, vineyards and vines, covering a considerable area, and situated at a distance of more than half a mile below the front of the flow, were suddenly dried up, just as if the blast of a fire had burnt up their foliage. In order to explain this curious phenomena, it is necessary to admit that some rivulets of the great lava river must have penetrated under the earth through the fissures of the soil, and have filled up a subterranean cavity in the mountain exactly below the vineyards that were destroyed; the roots being con-

sumed, or deprived of the necessary moisture, the trees themselves could not do otherwise than perish.

On lofty mountains in a state of eruption, the masses of snow and ice, which are covered by the fiery currents which issue from the volcanic fissures, do not always melt, and some have been preserved under the scoria for centuries, or even thousands of years. Lyell has discovered them under the lava of Etna, American geologists under the masses thrown out by the crater of Mount Hooker, Darwin under the ashes in Deception Island, in the Terra del Fuego, M. Philippi under the flows of the volcano Nuevo de Chillan, which in 1861 erupted through a glacier.

There every bed of snow which falls during the winter remains perfect under the coat of burning dust which is ejected from the outlet of eruption, and sections made through the mass of debris show for a great depth the alternate black and white strata of the volcanic ashes and the snow. In 1860 the crater of the mountain of Kutlagaya, in Iceland, hurled out simultaneously into the air lumps of lava and pieces of ice all intermingled together.

BURIED LAVA STILL BURNING.

In like manner, the immense flows of lava in Iceland have left in a perfect state of preservation the trunks of the Sequoias, and other American trees, which adorned the surface of the island during the ages of the Tertiary epoch, at a time when the mean temperature of this country was 48° (Fahr.); that is, 42° to 44° above that which it is at present. Although the radiation from the lava is so slight that it neither melts the ice nor burns the trunks of buried trees, yet, on the other hand, the heat and fluidity of the lava are maintained in the central part of the flow for a very considerable number of years. Travelers state that they have found deeply buried lava which was still burning after it had remained for a century on the mountain side.

Although the lava covers up and often preserves the snow and the ice, which are doubtless defended against the heat by a cushion of spheroidal particles of humidity, it immediately converts into steam the water with which it comes in contact. The

liquid mass, being suddenly augmented to about 1800 times its former volume, explodes like an enormous bombshell, and hurls away, like projectiles, all the objects which surround it. A serious occurrence of this kind is recorded, which took place in 1843, a few days after the formation of a fissure in Mount Etna, from which a current of molten matter issued, making its way toward the plain of Bronte.

A crowd of spectators, who had come from the town, were examining from a distance the threatening mass, the peasants were cutting down the trees in the fields, others were carrying off in haste the goods from their cottages, when suddenly the extremity of the flow was seen to swell up like an enormous blister, and then to burst, darting forth in every direction clouds of steam and volleys of burning stones. Everything was destroyed by this terrible explosion—trees, houses and cultivated ground; and it is said that sixty-nine persons, who were knocked down by the concussion, perished immediately, or in the space of a few hours.

LIKE GUNPOWDER.

This disaster was occasioned by the negligence of an agriculturist, who had not emptied the reservoir on his farm; the water, being suddenly converted into steam, had caused the lava to explode with all the force of gunpowder.

The quantity of molten matter which is ejected by a fissure in one single eruption is enormous. It is known that the current of Kilauea, in 1840, exceeded 6550 millions of cubic yards. That which proceeded from Mauna-Loa, in 1835, produced a still larger quantity of lava, and extended as far as a point seventy-six miles from the crater. Flows of this kind are certainly rare; but there are some recorded in the earth's history which are still more considerable. Thus the volcano of Skaptar-Jokul, in Iceland, was cleft asunder in 1873, and gave vent to two rivers of fire, each of which filled up a valley; one attained a length of fifty miles, with a breadth of fifteen miles; the other was of less dimensions, but the depth of the mass was in some places as much as 492 feet. A subterranean fissure, ninety-nine miles in length, which

cleaves in two the ground of Iceland, was doubtless filled up with lava along its entire length, for hillocks of eruption sprung up on various points of this straight line.

It has been calculated that the whole of the lava evacuated by the Skaptar in this great eruption was not less in bulk than 655,000 millions of cubic yards, a mass equivalent to the whole volume of Mont Blanc; it would be a quantity sufficient to cover the whole earth with a film of lava 0.0393 inch in thickness. As to the celebrated flow from the Monti Rossi, which threatened to destroy Catania, in 1669, it seems very trifling in comparison; it contained a mass of molten stone which was estimated at 1310 millions of cubic yards. On how trifling a scale, therefore, are these ordinary eruptions compared with the surface of the globe! They are, however, phenomena perceptible enough to man, in all his infinite littleness.

CHAPTER XXII

VOLCANIC PROJECTILES.—EXPLOSIONS OF ASHES.—SUBORDINATE VOLCANOES.—MOUNTAINS REDUCED TO DUST.—FLASHES AND FLAMES PROCEEDING FROM VOLCANOES.

THE lava swelling up in enormous blisters above the fissures from which it flows in a current over the slopes is far from being the only substance ejected from volcanic mountains. When the pent-up vapor escapes from the crater with a sudden explosion, it carries with it lumps of molten matter, which describe their curve in the air, and fall at a greater or less distance on the slope of the cone, according to the force with which they were ejected.

These are the volcanic projectiles, the immense showers of which, traced in lines of fire on the dark sky, contribute so much during the night time to the magnificent beauty of volcanic eruptions. These projectiles have already become partially cooled by their radiation in the air, and when they fall are already solidified on the outside, but the inside nucleus remains for a long time in a liquid or pasty state. The form of these projectiles is often of an almost perfect regularity.

Each sphere is in this case composed of a series of concentric envelopes, which have evidently been arranged in the order of their specific gravity during the flight of the projectile through the air. The dimensions of these projectiles vary in each eruption; some of them are one or more yards in thickness; others are nothing but mere grains of sand, and are carried by the wind to great distances.

In most eruptions, these balls of lava, still in a fluid and burning state, constitute but a small part of the matter thrown out by the mountain. The largest proportion of the stone ejected proceeds from the walls of the volcano itself, which break up under the pressure of the gas, and fly off in volleys, mingled with the products of the new eruption. This is the origin of the dust or

ashes which some craters vomit out in such large quantities, which too, are the causes of such terrible disasters.

When the impetus of the gas confines itself to forming a fissure in the side of the mountain, the fragments of rocks which are broken up and reduced to powder are comparatively small in quantity. They are projected in clouds out of the fissure, and, falling like hail round the orifice, are gradually heaped up in the form of a cone on the side of the mountain from which they arose. In Europe, the enormous circumference of Etna presents more than 700 of these subordinate volcanoes, some scarcely higher than an Esquimaux hut, and others, like the Monti Rossi, Monte Minardo, Monte Ilici, several hundred yards high, and more than half a mile wide at the base.

SCANTY GROWTH OF BROOM.

There are some which are entirely sterile, or covered only by a scanty vegetation of broom, and are marked out by a red, yellow, or even black color on the main body of Etna ; those situated on the lower slopes are covered with trees or planted with vines, and sometimes contain admirable crops in the very cavity on their summit. These cones of ashes, springing up like a progeny on the vast sides of their mother mountain, give to Etna a singular appearance of vital personality and of creative energy. The same phenomenon occurs on the volcanoes of Hawaii, which carry on their declivities thousands of subordinate cones.

In the formation of these hillocks a real division of labor takes place. The rocks and heavier stones fall either on the edge of the crater or in the gulf itself. The ashes and light dust are shot up to a much greater height, and, hurried along by the impulse of the wind, fall far and wide, like the chaff of corn winnowed in a threshing-floor. Thus the slope of the cone toward which the wind directs the ashes is always more elongated, and rises to a greater height on the edge of the crater. On Etna, where the wind generally blows in the direction of west to east, the eastern slope of the hillocks is more developed than on the opposite side. It must, perhaps, be attributed to the action of the wind blowing on the

heights, and not, as Siemsen, the geologist, supposes, to the obliquity of the shaft of the crater, that all the scoria and ashes fall to the north of the orifice of the volcano Nuevo de Chillan, in Chili.

The phenomena which take place when the ashes issue from the mouth of the crater itself do not differ from those which are observed at the outlets in fissures. In the former case, however, the mass of rocks reduced to powder is so considerable that the rain of ashes assumes all the proportions of a cataclysm. It has sometimes happened that, during a paroxysm of volcanic energy, the whole summit of a mountain, for a depth of several thousands of feet, has been hurled into the air, mingled with a cloud of vapor and the smoke of burning lava.

Thus Etna, if we are to believe Ælianus, was once much loftier than it is in our time, and on the north of the present terminal cone there may, in fact, be noticed a kind of platform which seems to have been the base of a summit twice as high as the present crest. The whole of the Val del Bove is probably an empty space left by the disappearance of a former cone.

REDUCED TO POWDER.

With regard to Vesuvius, it is known that, in the year 79 of the present era, the whole of that part of the mountain which was turned toward the sea was reduced to powder, and that the debris of the cone, nothing of which now remains except the semicircular inclosure of La Somma, buried three towns and a vast extent of plain. The ashes and dust, mingled with white vapor rising in thick eddies, ascended in a column to a point far above the summit of the volcano, until, having reached those regions of the atmosphere where the rarefied air could no longer sustain them, they spread out into a wide umbrella-like shape, the falling dust of which obscured the sky.

Pliny the younger compared this vault of ashes and smoke to the foliage of an Italian pine curving at an immense height over the mountain. Since this memorable epoch the height of the column of vapor has been measured which has issued from Vesu-

vious at the time of several great eruptions, and it has been sometimes found that it reached 23,000 to 26,000 feet; that is, six times higher than the summit of the volcano itself.

One of these explosions of entire summits which caused most terror in modern times was that of the volcano of Coseguina, a hillock of about 500 feet high, situated on a promontory to the south of the Bay of Fonseca, in Central America. The debris hurled into the air spread over the sky in a horrible arch several hundreds of miles in width, and covered the plains for a distance of 25 miles with a layer of dust at least 16 feet thick. At the very foot of the hill the headland advanced 787 feet into the bay, and two new islands, formed of ashes and stones falling from the volcano, rose in the midst of the water several miles away.

PUMICE-STONE ON THE WATER.

Beyond the districts close round the crater, the bed of dust, which fell gradually, became thinner, but it was carried by the wind more than forty degrees of longitude toward the west, and the ships sailing in those waters penetrated with difficulty the layer of pumice-stone spread out on the sea. To the north, the rain of ashes was remarked at Truxillo, Honduras, and at Chiapas, in Mexico; on the south, it reached Carthagena, Santa Martha, and other towns of the coast of Grenada; to the east, being carried by the counter current of the trade-winds, it fell on the plains of St. Ann's, in Jamaica, at a distance of 800 miles. The area of land and water on which the dust descended must be estimated at 1,500,000 square miles, and the mass of matter vomited out could not be less than 65,500 million cubic yards.

The uproar of the breaking up of the mountain was heard as far as the high plateaux of Bogota, situated 1025 miles away in a straight line. While the formidable cloud was settling down round the volcano, thick darkness filled the air. For forty-three hours nothing could be seen except by the sinister light of the flashes darting from the columns of steam, and the red glare of the vent holes opening in the mountain.

To escape from this prolonged night, the rain of ashes, and

the burning atmosphere, the inhabitants who dwelt at the foot of Coseguina fled in all haste along a road running by the black water of the Bay of Fonseca. Men, women, children, and domestic animals travelled painfully along a difficult path, through quagmires and marshes. So great, it is said, was the terror of all animated beings during this long night of horror, that the animals, themselves, such as monkeys, serpents, and birds, joined the band of fugitives, as if they recognized in man a being endowed with intelligence superior to their own.

A large number of volcanoes have diminished in height, or have, indeed, entirely disappeared, in consequence of explosions, which reduced their rocks to powder, and distributed them in thick sheets on the ground adjacent. Mount Baker, in California, and the Japanese volcano of Unsen, have thus raised the level of the surrounding plains at the expense of a diminution in their own volume. In 1638, the summit of the peak of Timor, which might be seen like a light-house from a distance of 270 miles, exploded, and blew up into the air, and the water collecting, formed a lake in the enormous void caused by the explosion.

GREAT DESTRUCTION OF LIFE.

In 1815, Timboro, a volcano in the island of Sumbara, destroyed more men than the artillery of both of the armies engaged on the battle-field of Waterloo. In the island of Sumatra, 550 miles to the west, the terrible explosion was heard, and, for a radius of 300 miles round the mountain, a thick cloud of ashes, which obscured the sun, made it dark like night even at noonday. This immense quantity of debris, the whole mass of which was, it is said, equivalent to thrice the bulk of Mont Blanc, fell over an area larger than that of Germany.

The pumice-stone which floated in the sea was more than a yard in thickness, and it was with some difficulty that ships could make their way through it. The popular imagination was so deeply impressed by this cataclysm, that at Bruni, in the island of Borneo, whither heaps of the dust vomited out by Timboro, 870 miles away to the south, had been carried by the wind, they

date their years from "the great fall of ashes." It is the commencement of an era for the inhabitants of Bruni, just as the flight of Mohammed was for the Mussulmans.

The friction of the steam against the innumerable particles of solid matter which are darted out into the air is the principal cause of the electricity which is developed so plentifully during most volcanic eruptions. In consequence of this friction, which operates simultaneously at all points in the atmosphere which are reached by the volcanic ashes, and vapor, sparks flash out which are developed into lightning. The skies are lighted up not only by the reflection from the lava, but also by coruscations of light which dart from amid the clouds.

When the vast canopy of vapor spreads over the summit of the mountains, numerous spirals of fire whirl round on each side of the clouds, which, as they unroll, resemble the foliage of a gigantic tree. Doubtless, also, the encounter of two aerial currents may contribute to produce lightning in the columns of vapor; yet, when the latter are slightly mingled with ashes, they are rarely stormy.

ACTUAL FIRES SEEN.

Although the evolution of electricity in the columns of vapor and ashes vomited out by volcanoes has never been called in question, the appearance of actual flames at the time of volcanic eruptions was for a long time disputed. M. Sartorius von Waltershausen, the patient observer of Etna, has maintained that neither this mountain, nor Stromboli, nor any other volcano, has ever presented among its phenomena any fire properly so called, and that the supposed flames were nothing more than the reflection of the red or white lava that was boiling in the crater.

On the other hand, Elie de Beaumont, Abich and Pilla positively assert that they have seen light flames on the summit of Vesuvius and Etna. It would, however, be very natural to believe that inflammable gases might be liberated and take fire at the outlet of those immense shafts which place the great subterranean laboratory of lava in communication with the outer air.

This question was, however, resolved in the affirmative at the time of the eruption of Santorin, and popular opinion was right in opposition to most men of science. All those who were able to witness, at its commencement, the upheaval of the lava at Cape Georges and Aphroessa, have certified to the appearance of burning gas dancing above the lava, and even on the surface of the sea. All round the upheaved hillocks, bubbles of gas, breaking forth from the waves, became kindled as they came in contact with the burning mass, and were diffused over the water in long trains of white, red or greenish flames, which the breeze alternately raised or beat down; sometimes a smart puff of wind put out the fire, but it soon recommenced to run over the breakers; by approaching it carefully, fragments of paper might be burnt in it, which lighted as they dropped. On the slopes of the volcano of Aphroessa fire, rendered of a yellowish hue by salts of soda, sprung out from all the fissures, and rose to a height of several yards. On the rather older lava of Cape Georges the trains of flame were less numerous; there, however, bluish glimmers might be seen flitting about in some spots over the black ridges of lava.

GROWING MOUNTAINS.

Added to this, are not the flames at Bakou, on the coast of the Caspian Sea, produced by the volcanic action of the ground? The "growing mountains" in the neighborhood are mud-volcanoes, and we must doubtless attribute to the same subterranean activity the production of the hydrogen gas which burns in an "eternal flame" in the temple of the Parsi. During some of the evenings in autumn, when the weather is fine and the sun has heated the surface of the ground, the flames occasionally make their appearance on the hills, and for several hours may be seen the marvelous spectacle of a train of fire stretching along the country without burning the ground, and even without scorching a blade of grass.

Next to lava and ashes, streams of water and mud are the most considerable products of volcanic activity, and the catastrophes which they have caused are perhaps among the most terri-

ble which history has to relate. By means of these sudden deluges, towns have been swept away or swallowed up, whole districts dotted over with habitations have been flooded with mud or converted into marshes, and the entire face of nature has been changed in the space of a few hours.

The liquid masses which descend rapidly from the mountain height do not always proceed from the volcano itself. Thus the local deluge may be caused by a rapid condensation of large quantities of steam which escape from the crater and fall in torrents on the slopes. A phenomenon of this kind must evidently take place in a great many cases, and it was doubtless by a cataclysm of this kind that the town of Herculaneum, at the foot of Vesuvius, was buried.

MELTED SNOW AND ICE.

As regards the lofty snow-clad volcanoes of the tropical and temperate zones, and also those of the frozen regions, the torrents of water and debris—the “water-lava,” as the Sicilians call them—may be explained by the rapid melting of immense masses of snow and ice, with which the burning lava, the hot ashes, or the gaseous emanations of the volcanic furnace have come in contact. Thus, in Iceland, after each eruption, formidable deluges, carrying with them ice, scoria, and rocks, suddenly rush down into the valleys, sweeping away everything in their course.

These liquid avalanches are the most terrible phenomena which the inhabitants of the island have to dread. They show three headlands formed of debris, which the body of water descending from the sides of Kutlugaya in 1766 threw out far into the sea, in a depth of 246 feet of water.

Other deluges no less formidable are caused by the rupture of the walls which pen back a lake in the cavity of a former crater, or by the formation of a fissure which affords an outlet to liquid masses contained in subterranean reservoirs. It would be too difficult to explain otherwise the mud-eruptions of several trachytic volcanoes of the Andes—Imbambaru, Cotopaxi, and Carahuarizo. In fact, the mud which comes down from these

mountains often contains a large quantity of organized beings, aquatic plants, infusoria, and even fish, which could only have lived in the calm waters of a lake.

Of this kind is the *Pimelodes cyclopum*, a little fish of the tribe of the *Silurida*, which according to Humboldt, has hitherto been found nowhere except in the Andini caverns and in the rivulets of the plateau of Quito. In 1691 the volcano of Imbambaru vomited out, in combination with mud and snow, so large a quantity of these remains of organisms that the air was contaminated by them, and miasmatic fevers prevailed in all the country round. The masses of water which thus rush down suddenly into the plains amount sometimes to millions, or even thousands of millions of cubic yards.

UNDERGROUND LAKES.

Although, in some cases, these eruptions of mud and water may be looked upon as accidental phenomena, they must, on the contrary, as regards many volcanoes, be considered as the result of the normal action of the subterranean forces. They are, then, the waters of the sea or of lakes which, having been buried in the earth, again make their appearance on the surface, mingled with rocks which they have dissolved or reduced to a pasty state.

A remarkable instance of these liquid eruptions is that presented by Papandayang, one of the most active volcanoes in Java. In 1792 this mountain burst, the summit was converted into dust and disappeared, and the debris, spreading far and wide, buried forty villages. Since this epoch a copious rivulet gushes out in the very mouth of the crater, at a height of 7710 feet, and runs down into the plain, leaping over the blocks of trachyte. Round the spring pools of water fill all the clefts in the rocks, and boil up incessantly under the action of the hot vapors which rise in bubbles; here and there are funnel-shaped cavities, in which black and muddy water constantly ascends and sinks with the same regularity as the waves of the sea; elsewhere, muddy masses slowly issuing from small craters flow in circular slopes over mounds of a few inches or a yard in height; lastly, jets of steam dart out of

all the fissures with a shrill noise, making the ground tremble with the shock.

All these various noises, the roaring of the cascades, the explosion of the gaseous springs, the hoarse murmur of the mud-volcanoes, the shrill hissing of the fumaroles, produce an indescribable uproar, which is audible far away in the plains, which, too, has given to the volcano its name of Papandayang, or "Forge," as if one could incessantly hear the mighty blast of the flames and the ever-recurring beating of the anvils.

In volcanoes of a great height it is rarely found that eruptions of water and mud are constant, as in the Papandayang; but temporary ejections of liquid masses are frequent, and there are, indeed, some volcanoes which vomit out nothing but muddy matter. The volcano of Aqua (or water), the cone of which is gently inclined like that of Etna, and rises to about 13,000 feet in height, into the regions of snow, has never vomited anything but water; and it is, indeed, stated that lava and other volcanic products are entirely wanting on its slopes.

INHABITANTS DRIVEN OUT.

Yet in 1541, this prodigious intermittent spring hurled into the air its terminal point and poured over the plains at its base, and over the town of Guatemala, so large a quantity of water, mingled with stones and debris, that the inhabitants were compelled to fly with the greatest haste, and to reconstruct their capital at the foot of the volcano of Fuego. This new neighbor, however, showed that he was as much or more to be dreaded than their former one, for the violent eruptions from the mountain compelled the inhabitants of the second town to again migrate and to rebuild their capital at a point twenty miles to the north-west.

Several volcanoes in Java and the Philippines also give vent, during their eruptions, to large quantities of mud, sometimes mingled with organic matter in such considerable proportions that they have been utilized as fuel. In 1793, a few months after the terrible eruption of Unsen, in the island of Kioussiou, an adjacent

volcano, the Miyi-Yama, vomited, according to Kampfer, so prodigious a quantity of water and mud that all the neighboring plains were inundated, and 53,000 people were drowned in the deluge ; unfortunately, we have no historical details of this catastrophe. Of all the eruptions of mud, the best known is that of Tunguragua, a volcano in Ecuador, which rises to the south of Quito to 16,400 feet in height.

In 1797, at the time of the earthquake of Riobamba, a whole side of the mountain sank in the downfall, with the forests which grew on it ; at the same time, a flow of viscous mud issued from the fissures at its base, and rushed down into the valleys. One of these currents of mud filled up a winding defile, which separated two mountains, to a depth of 650 feet, over a width of more than 1000 feet, and damming up the rivulets at their outlet from the side valleys, kept back the water in temporary lakes ; one of these sheets of water remained for eighty-seven days.

A CURIOUS TRANSITION.

The volcanic mud, therefore, has this point of resemblance with the lava—that it sometimes flows out through the crater, as on Papandayang ; sometimes through side craters, as on Tunguragua. Doubtless, when the volcanic muds have been better studied, we shall be enabled to trace the transition which takes place by almost imperceptible degrees between the more or less impure water escaping from volcanoes, and the burning lava more or less charged with steam. This transition is, however, already noticed in the ancient matter which the water has carried down and deposited in the strata at the foot of volcanic mountains. These rocks, known under the name of tufa, trass, or perperino, are nothing but heaps of pumice, scoria, ashes, and mud, cemented together by the water into a species of mortar or conglomerate, and gradually solidified by the evaporation of the humidity which they contained.

Of this kind, for instance, is the hardened stone which, for eighteen centuries, has covered the city of Herculaneum with a layer of 50 to 150 feet in thickness. Among rocks of various

formations, there are but few which exhibit a more astonishing diversity than the tufas. They differ entirely in appearance and physical qualities, according to the nature of the materials which have formed them, the quantity of water which has cemented them, the greater or less rapidity with which their fall and desiccation take place; lastly, the number and distribution of the chinks which are produced across the dried mass, and have been filled up with the most different substances. Many kinds of tufa resemble the most beautiful marble.

LITTLE CONES.

The small hillocks, which are specially called mud-volcanoes, or salses, on account of the salts which are frequently deposited by their waters, are cones which differ only in their dimensions from the mighty volcanoes of Java or the Andes. Like these great mountains, they shake the ground, and rend it, in order to discharge their pent-up matter; they emit gas and steam in abundance, add to their slopes by their own debris, shift their places, change their craters, throw off their summits in their explosions; lastly, some of these salses are incessantly at work, while others have periods of repose and activity. In nature, transitions merge into one another so perfectly, that it is difficult to discover any essential difference between a volcano and a salse, and between the latter and a thermal spring.

Mud-volcanoes exist in considerable numbers on the surface of the earth, and, like the volcanoes of lava, the neighborhood of the sea-coast is the principal locality where we find their little cones. In Europe, the most remarkable are those which are situated at the two extremities of the Caucasus, on the coasts of the Caspian Sea, and on both sides of the Straits of Yenikale, which connect the Sea of Azof with the Black Sea. On the east, the mud-springs of Bakou are especially distinguished by their combination with inflammable gases; on the west, those of Taman and Kertch flow all the year round, but especially during times of drought, pouring out large quantities of blackish mud. One of these mud-volcanoes, the Gorela, or Kuku-Oba, which, in the

time of Pallas, was called the "Hell," or Prekla, on account of its frequent eruptions, is no less than 246 feet in height, and from this crater, which is perfectly distinct, muddy streams have flowed one of which was 2624 feet long, and contained about 850,000 cubic yards.

The volcanitos of Turbaco, described by Humboldt, and the maccalube of Girgenti, which have been explored, since Dolomieu, by most European savants who have devoted themselves to the study of subterranean forces, are also well-known examples of mud-springs, and may serve as a type to all the hillocks of the same character. In winter, after a long course of rains, the plain is a surface of mud and water forming a kind of boiling paste, from which steam makes its escape with a whistling noise; but the warmth of spring and summer hardens this clay into a thick crust, which the steam breaks through at various points and covers with increasing hillocks. At the apex of these cones a bubble of gas swells up the mud like a blister, and then bursts it, the semi-liquid flowing in a thin coat over the mound; then a fresh bubble ejects more mud, which spreads over the first layer already become hard, and this action continues incessantly until the rains of winter again wash away all the cones.

DEPENDENT ON THE TIDES.

This is the ordinary course of action of the salse, sometimes interrupted by violent eruptions. On the coast of Mekran the mud-volcanoes are not only subject to the action of the seasons, but also depend on the action of the tides, although many of them are from 9 to 12 miles from the Indian Ocean. At the time of the flow the mud rises in great bubbles, accompanied by a hoarse murmur, like the distant roar of thunder. The highest cone is not more than 246 feet high, and stands seven miles from the shore.

In a general way, the expulsion of mud and gas is accompanied by a discharge of heat, but in some salses, like those of Mekran, the matter ejected is not higher in temperature than the surrounding air, as if the expulsion of the mud from the ground was an entirely superficial phenomenon. Occasionally, in peat

bogs, the ground cracks and cold mud is ejected from the fissure ; and then, after this kind of eruption, the spongy soil sinks and again levels down. Is this eruptive phenomenon similar to that presented by the mud volcanoes, and caused by the fermentation of gases in the midst of substances in a state of putrefaction ? This is M. Otto Volger's idea ; and it would be difficult to give any other explanation of the phenomenon.

CHAPTER XXIII.

VOLCANIC THERMAL SPRINGS. — GEYSERS. — SPRINGS IN NEW ZEALAND. — CRATERS OF CARBONIC ACID.

VOLCANOES, both of lava and mud, all have, either on their sides or in the vicinity of their base, thermal springs, which afford an outlet to their surplus water, gas, and vapor. Most even of those mountains which are at present tranquil, but which were once centres of eruption, continue to manifest their activity by vapors and gas, like furnaces in which the flames are extinct, but the smoke is still rising. Although lava and ashes no longer make their escape from the crater of lateral fissures, yet numerous hot springs, formed by the condensation of the steam, generally serve as a vehicle for the gas pent up in the depths of the mountain.

We may reckon by hundreds and thousands the “geysers,” the “vinegar springs,” and other thermal springs in countries once burning with volcanoes, the fires of which are extinct, or at least quieted down for a period more or less protracted. Thus the former volcanoes of Auvergne; the mountains of the Eifel, on the Rhine, the craters of which contain nothing but lakes or pools; the Demavend, with its mouth filled up with snow—all still exhale here and there, through springs, as it were, a feeble breath of their once mighty vitality.

The volcanic regions of the earth where thermal springs gush out, are very numerous. In Europe we have Sicily, Iceland, Tuscany, and the peninsula of Kertch, and Yellowstone Park, in America—land so rich in volcanoes—the springs warmed by subterranean vapor are still more numerous, and there are some on the sides of the volcano Nuevo del Chillan which gush out through a thick bed of perpetual snow.

A lateral gorge of the valley of Napa, in California, called the “Devil’s Canyon,” may be quoted as one of the most striking examples of the active production of thermal waters. The narrow

ravine, filled with vapor rising in eddies, opens on the side of a red and bare mountain, that one might fancy was scorched by fire. The entry to the ravine follows the course of a rivulet, the boiling waters of which are mingled with chemical substances horrible to the taste. Innumerable springs—some sulphurous, others charged with alum or salt—gush out at the base of the rocks. There are both warm and cold springs, and hot and boiling; some are blue and transparent, others white, yellow or red with ochre. In a cavity which is called the "Sorcerers' Caldron" a mass of black and fetid mud boils up in great bubbles.

Higher up, the "Devil's Steam-boat" darts out jets of gaseous matter, which issue puffing from a wall of rock: fumerolles may be seen by hundreds on the sides of the mountain. All these various agents either murmur, whistle, rumble or roar, and thus a tempest of deafening sounds incessantly fills the gorge. The burning ground, composed of a clayey mud—in one spot yellow with sulphur, and in another white with chalk—gives way under the feet of the traveler who ventures on it, and gives vent to puffs of vapor through its numberless cracks. The whole gorge appears to be the common outlet of numerous reservoirs of various mineral waters, all heated by some great volcanic furnace.

THE DEVIL'S CANYON.

The ravine of Infernillo (Little Hell), which is situated at the base of the volcano of San Vincente, in the centre of the Republic of San Salvador, presents phenomena similar to those of the "Devil's Canyon." There, too, a multitude of streams of boiling water gush from the soil, which is calcined like a brick, and eddies of vapor spring from the fissures of the rock with a noise like the shrill whistle of a locomotive. The most considerable body of water issues from a fissure 32 feet in width which opens under a bed of volcanic rocks at a slight elevation above the bottom of the valley.

The liquid stream, partially hidden by the clouds of vapor which rise from it, is shut out to a distance of 130 feet as if by a force-pump, and the whistling of the water pent up between the

rocks reminds one of the furnace of a manufactory at full work. One might fancy that it was the respiration of some prodigious being hidden under the mountain.

The hottest springs which gush out on the surface of the ground, such as those of Las Trincheras and Comangillas, do not reach the temperature of 212° (Fahr.); but we have no right to conclude from this that the water in the interior of the earth does not rise to a much more considerable heat. It is, on the contrary, certain that water descending into the deepest fissures of the earth although still maintaining a liquid state, may reach, independently of any volcanic action, a temperature of several hundred degrees; being compressed by the liquid masses above it, it is not converted into steam. At a depth which is not certainly known, but which various savants have approximately fixed at 49,000 feet, water of a temperature exceeding 750° (Fahr.) ultimately attains elasticity sufficient to overcome the formidable weight of 1500 atmospheres which presses on it; it changes into steam, and in this new form mounts to the surface of the earth through the fissures of the rocks.

FRESH JETS OF STEAM.

Even if this steam, passing through beds of a gradually decreasing temperature, is again condensed and runs back again in the form of water, still it heats the liquid which surrounds it, and increases its elasticity; it consequently assists the generation of fresh jets of steam, which likewise rise toward the upper regions. Thus, step by step, water is converted into steam up to the very surface of the earth, and springs out from fissures.

In Iceland, California, New Zealand and several other volcanic regions of the world, jets of steam mingled with boiling water are so considerable as to rank among the most astonishing phenomena of the planet. The most celebrated, and certainly the most beautiful, of all these springs is the Great Geyser of Iceland. Seen from afar, light vapors, creeping over the low plain at the foot of the mountain of Blafell, point out the situation of the jet of water and of the neighboring springs. The basin of siliceous stone

which the Geyser itself has formed during the lapse of centuries is no less than fifty-two feet in width, and serves as the outer inclosure of a funnel-shaped cavity, seventy-five feet deep, from the bottom of which rise the water and steam. A thin liquid sheet flows over the edges of the basin, and descends in little cascades over the outer slope.

The cold air lowers the temperature of the water on the surface, but the heat increases more and more in all the layers beneath; every here and there bubbles are formed at the bottom of the water, and burst when they emerge into the air. Soon bodies of steam rise in clouds in the green and transparent water, but, meeting the colder masses on the surface, they again condense. Ultimately they make their way into the basin, and cause the water to bubble up; steam rises in different places from the liquid sheet, and the temperature of the whole basin reaches the boiling-point; the surface swells up in foamy heaps, and the ground trembles and roars with a stifled sound. The cauldron constantly gives vent to clouds of vapor, which sometimes gather round the basin, and sometimes are cleared away by the wind.

LEAP OUT WITH A CRASH.

At intervals, a few moments of silence succeed to the noise of the steam. Suddenly the resistance is overcome, the enormous jet leaps out with a crash, and, like a pillar of glittering marble, shoots up more than 100 feet in the air. A second and then a third jet rapidly follow; but the magnificent spectacle lasts but for a few minutes. The steam blows away; the water, now cooled, falls in and round the basin; and for hours, or even days, a fresh eruption may be waited for in vain. Leaning over the edge of the hole whence such a storm of foam and water has just issued, and looking at the blue, transparent, and scarcely-rippled surface, one can hardly believe, says Bunsen, in the sudden change which has taken place.

The slight deposits of siliceous matter which are left by the evaporation of the boiling water have already formed a conical hillock round the spring, and, sooner or later, the increasing curb

of stone will have so considerably augmented the pressure of the liquid mass in the spring that the waters must ultimately open a fresh outlet beyond the present cone. From the experiments and observations made by Forbes as to the formation of the layer of incrustations round the jet, this spring must have commenced its eruptions ten centuries and a half ago, and they will probably cease in a much shorter space of time.

Not far from the Geyser, the mound of deposits from which is not less than 39 feet in height, there are a number of pools which once acted as basins for springs which gushed up through them, but are now nothing but cisterns filled with blue and limpid water, at the bottom of which may be seen the mouth of a former channel of eruption. A shifting in the position of the centre of activity takes place in the Geyser, just as in mud volcanoes and incrusting springs. Several springs lying on the same terrestrial fissure as the great jet d'eau, the Strokkur, the Small Geyser, and some others, present phenomena which are nearly similar, and are evidently subject to the action of the same forces.

IN CONTACT WITH HOT LAVA.

The vicinity of the active volcanoes of Iceland warrants us, however, in supposing that the water produced by the melting of the snow on Blafell does not require to descend many thousands of yards into the earth in order to be converted into steam. There is no doubt that, at no very great depth below the surface, they come in contact with burning lava, which gives them their high temperature. By reproducing in miniature all the conditions which are thought to apply to the Icelandic springs—that is, by heating the bases of tubes of iron filled with water and surmounted by a basin—Tyndall succeeded in producing in his laboratory charming little geysers, which jetted out every five minutes.

About the centre of the northern Island of New Zealand the activity of the volcanic springs is manifested still more remarkably even than in Iceland. On the slightly winding line of fissure which extends from the southwest to the northeast, between the ever active volcano of Tongariro and the smoking island of

Whakari, in Plenty Bay, thermal springs, mud fountains, and geysers rise in more than a thousand places, and in some spots combine to form considerable lakes.

In some localities the hot vapors make their escape from the sides of the mountains in such abundance that the soil is reduced to a soft state over vast surfaces, and flows down slowly to the plains in long beds of mud. For a distance of more than a mile a portion of the Lake of Taupo boils and smokes as if it was heated by a subterreanean fire, and the temperature of its water reaches, on the average to 100° (Fahr.). Farther to the north, the two sides of the valley, through which flows the impetuous river of Waikato after its issue from Lake Taupo, present, for more than a mile, so large a number of water jets, that in one spot as many as seventy-six are counted. These geysers, which rise to various heights, play alternately, as if obeying a kind of rhythm in their successive appearances and disappearances.

While one springs out of the ground, falling back into its basin in a graceful curve bent by the wind, another ceases to jet out. In one spot a whole series of jets suddenly become quiet, and the basins of still water emit nothing but a thin mist of vapor. Farther on, however, the mountain is all activity; liquid columns all at once shine in the sun, and white cascades fall from terrace to terrace toward the river. Every moment the features of the landscape are being modified, and fresh voices take a part in the marvelous concert of the gushing springs.

About the middle of the interval which separates the Lake of Taupo from the coast of Plenty Bay, several other volcanic pools are dotted about, all most remarkable for their thermal and jetting springs. One of them, however, is among the great wonders of the world. This is the Lake of Rotomahanna, a small basin of about 120 acres, the temperature of which, being raised by all the hot springs which feed it, is about 78° (Fahr.). Dr. von Hochstetter has not even attempted to count the basins, the funnels, and the fissures from which the water, steam-mud, and sulphurous gases make their escape.

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